Embedding an Intelligent Tutor into existing Business Software to provide On-the-Job Training

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A thesis
submitted in partial fulfilment
of the requirements for the Degree
of
Master of Science in Computer Science
by
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Supervising Committee

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Abstract

Traditional on-the-job training for software typically involves human tutoring, training videos, manuals and open-ended exploration of the software. This Masters Thesis investigates embedding a constraint-based intelligent tutor into an existing business software system to enhance the training options for new users. Chreos Tutor, developed using the ASPIRE authoring system, is embedded into Chreos business software. It provides opportunities for users to practice two different types of data input tasks in the actual software environment. The student interface in Chreos Tutor is the combination of a new tutoring screen and existing data input screens. The main learning tool of a constraint-based tutor is the feedback on performance errors. In order to evaluate the effectiveness of the feedback provided by Chreos Tutor, the experimental group were given feedback pertaining to individual errors in the submitted solution, whereas the control group received no feedback while working on a task. Analysis of pre-test and post-test results indicated that participants who received feedback while working on a task achieved a higher learning gain than participants who were presented with the ideal solution after submitting their solution. This suggests that Chreos Tutor is effective at teaching data input tasks to new users.

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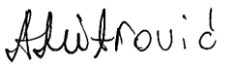
Name: *Tanja Mitrovic* Signature:  Date:*21.3.2016*

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Under review: 70%. I developed the software that was embedded inside the Chreos business system for the research project and modelled the domain within the ASPIRE authoring system. I also organized and ran the evaluation study. My co-authors were involved in the design process and provided guidance for the design and analysis of the evaluation study.

Certification by Co-authors:

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The undersigned certifys that:

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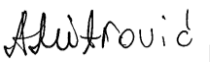
Name: *Tanja Mitrovic* Signature:  Date: *21.3.2016*

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Chapter I

Introduction

An Intelligent Tutoring System (ITS) is a practical learning tool for people wanting to acquire new skills. Each ITS has a task domain, which are the skills being taught by the tutor [VanLehn, 2006]. It models each learner individually by collecting data about student actions, processing that data and storing it as a student model. This model describes in some way the progress a student has made in learning the task domain. The system also implements a teaching strategy, where feedback is dependent on student actions and the next task is selected after consulting the student model. It provides problems, tasks or examples for users to attempt and gives feedback during those attempts. Learning occurs from this process. ITSs have been successful in a range of instructional domains such as algebra [Koedinger et al., 1997], physics [VanLehn et al., 2005], database design [Mitrovic, 2012] and genetics [Corbett et al., 2013].

On-the-job training takes place in the real work environment and is specific to the actual tasks and problems that occur in that environment. The nature of such training depends on the type of environment and the skills that need to be acquired. Traditional approaches to on-the-job training for software include human tutoring, training videos, a range of documentation including training manuals and open ended exploration of the software. Rieman [1996] conducted a field study investigating the learning behaviour and attitudes of computer users in everyday working situations. Participants in the study kept diaries and participated in structured interviews that focused on learning events. The results of the study suggested that the main focus of software users in a job situation is on successful completion of their tasks within the minimum time frame. Time pressure tends to favour a 'just in time' task-driven approach to acquiring software skills.

Chreos is an existing integrated business software system used by businesses of different sizes, in a range of industry sectors and across a number of different countries[1]. Users enter data and transactions to relevant modules including Point of Sale, Debtors, Creditors, Inventory and General Ledger. The system also allows users to view data and produce a range of reports on that data. Training of new users often incorporates human tutoring by one or more support personnel. The training may take place at the business premises or remotely, where support staff can see the desktop of the user and talk them through the process via telephone. Each client of Chreos can also set up a 'Practice Company' which is either a copy of their current database or of an earlier backup. This enables users to try out various tasks, without impacting live data. They can enter an actual piece of data into the 'Practice Company' and view the impact of this data on other values in the database. This type of exploratory learning is more suited to users who have some experience of what the impact should be. New users would generally need to consult an experienced user or support person. There are also some training videos and a range of web-based help documentation.

All traditional on-the-job training approaches for software have their limitations. Human tutoring is expensive, so users may not undertake an optimum amount of this type of training. Less personalised options such as training videos and documentation do not offer the same guidance and lack feedback. Exploratory learning can be inefficient and may not focus on the essential skills. At a minimum, these limitations can result in the full potential of the software not being realized. At the other end of the scale, they can result in the software being used incorrectly. Embedding an ITS in the software would provide an alternative training option for new users, which may overcome some of these limitations. ITSs are expensive to develop, but the cost per hour of training reduces as the number of students trained by the system increases. Users would learn by practising on a sequence of realistic graduated tasks in the actual software environment, at their convenience. They would receive fine-grained task specific feedback while attempting each task.

[1] http://www.chreos.com

The main objective of this research is to investigate whether an ITS embedded into Chreos business software will be effective in teaching new users how to complete tasks in Chreos.

The next chapter describes related work. This includes sections on ITSs, the ASPIRE authoring system for developing constraint-based tutors, some of the related work that has been done integrating ITSs into existing systems and the Chreos business system. This is followed by chapters on the design and evaluation of Chreos Tutor. The last chapter presents our conclusions.

Chapter II

Related Work

In this chapter we briefly discuss the common types of Intelligent Tutoring Systems, look at the ASPIRE authoring system for developing Constraint-Based Tutors and some of the related work that has been done integrating ITSs into existing systems. We also describe the Chreos Business System.

2.1 Intelligent Tutoring Systems

ITSs traditionally contain a domain or expert model, a student model, a pedagogical or teaching model and a user interface [Woolf, 2009]. The domain model contains the knowledge or skills to be imparted to students. The student model contains some estimate of the current state of each student's knowledge and possibly some background information about them. The teaching model implements a teaching strategy and determines the tutor's response to each student with respect to feedback and problem selection. The user interface facilitates communication between the student and the ITS. A typical ITS architecture is shown in Figure 2.1.

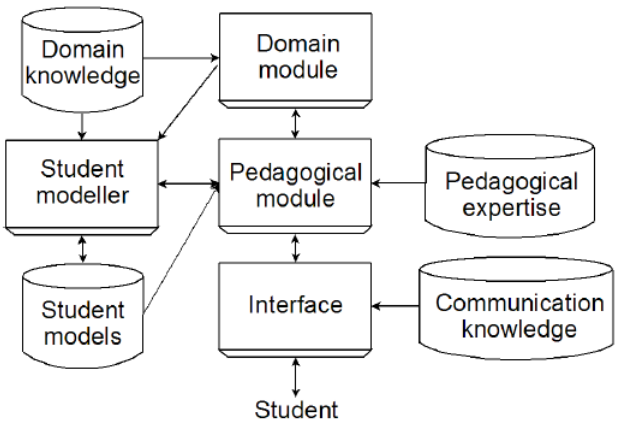

Figure 2.1: Typical ITS Architecture

ITSs can be classified in terms of the learning theory they attempt to implement. Cognitive or Model Tracing Tutors (MTTs) [Anderson et al., 1990] implement an approach based on the Adaptive Character of Thought-Rational (ACT-R) theory [Anderson, 1983]. MTTs focus on learning the correct problem-solving procedure. They model a set of correct and incorrect 'if-then' production rules for completing problems in a particular skill area. While students are solving these problems, the tutor traces their actions on a step-by-step basis and compares them to the rules in the model. Rules modelling incorrect behaviour generate feedback which indicates to students when and how their solution steps deviate from what is expected. Cognitive tutors have been developed to help students learn problem-solving skills in a range of domains, including algebra [Koedinger et al., 1997] and genetics [Corbett et al., 2010].

Each production rule is written as an 'if-then' pair. The 'if' part of the rule consists of a goal and a state or context. The 'then' part specifies the action and/or the new goal or state to be achieved. The following example shows a correct production rule for adding two fractions with different denominators.

IF: the goal is to add two fractions and the denominators are different

THEN: find the lowest common denominator

Constraint Based Tutors (CBT) implement an approach based on learning from performance errors [Ohlsson, 1996]. CBTs focus on whether the current state of the solution is correct or incorrect and not on the steps used to get to that solution. These tutors also implement constraint-based modelling, where domain knowledge is represented as a set of constraints [Ohlsson, 1994]. If an incorrect student solution violates any constraints, CBTs present the student with feedback from those violated constraints. This feedback typically indicates which domain concept has been violated and how the incorrect solution has achieved this violation. CBTs have been developed for a wide range of domains [Mitrovic, 2012], including database systems [Mitrovic et al., 2004][Suraweera and Mitrovic, 2004], computer programming [Holland et al., 2009], object-oriented software design [Baghaei et al., 2007], capital investment analysis [Mitrovic et al., 2008] and thermodynamics [Mitrovic et al., 2011].

Each constraint in a CBT has two parts [Mitrovic et al., 2007]. The first part or relevance condition checks whether the constraint is relevant to the type of task being completed. If a constraint is relevant, the second part or satisfaction condition checks whether the solution to the task satisfies the constraint. The following example shows both conditions of a constraint related to fraction addition.

Relevance: If two fractions are being added and the numerator of the resulting fraction equals the sum of the two starting numerators

Satisfaction: Then the denominators had better be the same

Each constraint has one or more feedback messages attached to it, which is provided to the student whenever the constraint is not satisfied by the student's solution. For the above example a feedback message could be 'You can only add the numerators of the two given fractions if their denominators are the same. When the denominators are different you need to find the lowest common denominator'. The short-term student model comprises a list of all relevant constraints for attempted problems, plus a record of whether each has been satisfied or violated. The CBT then uses this information to

update the long-term student model, reflecting the student's understanding of the domain.

ITSs are complex and time-consuming to develop. A range of authoring tools have been developed in an attempt to reduce the authoring effort these systems require. Murray [2003] provides a detailed analysis of some older authoring tools. Aleven et al. [2009] reports on the progress made with the Cognitive Tutor Authoring Tools (CTAT) project, a suite of authoring tools for cognitive and example-tracing tutors. WETAS (Web-Enabled Tutor Authoring System) and WETAS-Ontology are early authoring tools for CBTs [Martin et al., 2007]. WETAS is the precursor to the ASPIRE authoring system, which is described in the next section.

2.2 ASPIRE

ASPIRE is a web-based authoring and deployment system for creating and deploying constraint-based tutors [Mitrovic et al., 2006] [Mitrovic et al., 2009]. ASPIRE provides a mechanism for domain experts with no programming experience to develop and deploy CBTs. ASPIRE-Author provides a web-based interface that facilitates the authoring process. ASPIRE-Tutor is a web-based server that makes the deployed tutor available to students. Figure 2.2 provides a high-level view of the system.

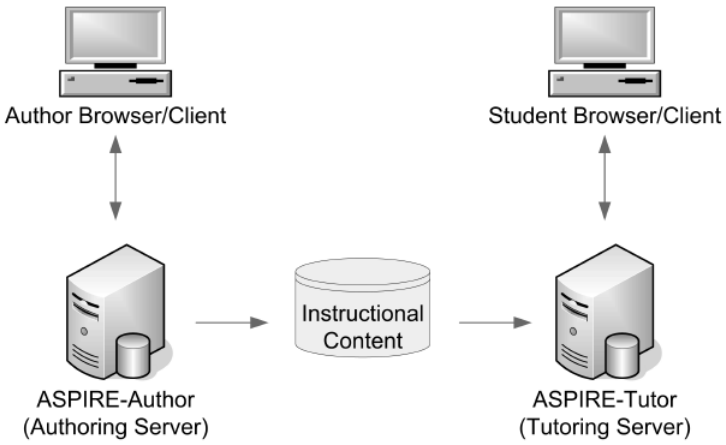

Figure 2.2: ASPIRE Architecture [Mitrovic et al., 2009]

ASPIRE-Author breaks the authoring process down into a sequence of steps. This section provides a brief description of what is involved. Additional detail can be seen in Section 3.2 which describes the modelling of domains for Chreos Tutor.

The first phase of the authoring process is to model the domain structure. Each domain must be given a name, description and a type. The type can either be non-procedural or procedural. A non-procedural domain contains a single step. If the domain is procedural, the author must specify the steps in the correct order. Each domain also contains one or more problem sets, which are identified via a name and description.

The most critical phase of the authoring process is the design of the domain ontology. This involves breaking the domain down into a hierarchy of concepts, describing any properties of those concepts and any relationships between them. This task is completed in the ontology workspace in a diagrammatic format. It is important to consider the types of tasks students will be solving for the domain, so that concepts directly related to these tasks are included and irrelevant concepts are excluded.

Authors must also model the structure of problems and their solutions. The problem structure includes a problem statement and can also have a list of components. For non-procedural tasks the solution structure is a single list of components. For procedural tasks the solution structure is separately modelled for each step in the process. For each component in the solution structure the author must specify a label, choose the type of concept from the domain ontology that it should contain, select the element count and indicate whether the component can be freely typed in by students. The element count indicates whether the component is optional or mandatory and whether it should contain single or multiple elements when specified.

The next phase is to model the student interface. ASPIRE provides a default interface. If this is not suitable the author can choose to supply a customised applet. ASPIRE also supports communication over a network via a remote procedure calls (RPC) protocol, which allows the interface to reside in an external application.

Once the student interface is completed the author must enter example tasks and their solutions for each problem set specified in the domain struc-

ture. These are entered into the Problem/Solution Editor which is similar in appearance to the student interface.

After all these steps have been completed the author can ask ASPIRE to generate syntax and semantic constraints. Each constraint has two associated default feedback messages, which can be modified to make them more useful to students. It is also possible to manually modify these constraints or add others, before deploying the tutor on the web.

2.3 ITSs Integrated with Existing Systems

A number of ITSs have been embedded in a range of existing software. Some of these are described here.

Genesereth [1979] developed MACSYMA Advisor, an early system that runs on top of MACSYMA to provide users with interactive assistance. MACSYMA is a system where users can simplify and combine mathematical equations. MACSYMA Advisor has a detailed user model to interpret user actions. It communicates with the user to verify that this interpretation is correct and then gives advice to correct any user misconceptions.

Ritter and Koedinger [1996] investigated plugging tutoring support into existing software tools in an attempt to provide an alternative to comprehensive one-off ITSs. These plug-in tutors may not incorporate all the features of an ITS, but may provide useful learning tools at a significantly reduced development cost. Cognitive tutors were embedded into existing software tools Geometer Sketchpad and Microsoft Excel. Analysis of the resulting systems indicated that such systems should comprise four components. The first component is the software tool within which the user operates. This tool must make some parts of the tutor visible to the user, provide information on user actions and be able to display feedback from the tutor in some way. The second component is a 'Tutor Agent' which evaluates user actions and responds so that the user knows how they are performing. Thirdly, a 'Curriculum Manager' is needed for determining appropriate problems for the user. The final component is a 'Translator' for handling communication and language translation between the first two components. This type of architecture allows the tutoring components and software tools to be independent

of each other, making plug-in Tutor Agents a realistic option.

Cheikes et al. [1998] developed an Embedded Training System (ETS) for a military information system helping trainees practice problem-solving tasks related to military exercises. The application interface module extracted information on all user actions inside the military information system and reported those to an interpretation module. The interpretation module used this information to update the system model of the user's problem-solving process. This was compared to an 'expert' problem-solving process and any deviations noted. The training module used this information to provide appropriate feedback when users requested a hint.

Gonzalez et al. [2007] extended STIM-Tutor, a case based reasoning ITS for health education, with the Health Level 7 (HL7) messaging protocol. STIM-Tutor was originally integrated with SINCO-TB, a Health Information System (HIS) database that contained information about patients with tuberculosis. The addition of the HL7 protocol allowed patient information from multiple HISs to be part of the knowledge base for health sector ITSs.

Risco and Reye [2012] presented an ITS developed at the Queensland University of Technology to help students learn to develop forms and reports in Microsoft Access. Students could access the Personal Access Tutor (PAT) via an additional group in the Microsoft Access ribbon. Tutor exercises covered the whole curriculum of a Databases course and was also used for assignments in that course. Exercises could be selected by students or the tutor and could be filtered by topic or level of difficulty. There were multiple levels of feedback, which became more specific. However the feedback never included the details of the correct solution, as some exercises were part of course assignments.

Amalathas et al. [2012] embedded a CBT (DM-Tutor) within an existing management information system (MIS) for oil palm plantation management. DM-Tutor was developed using the ASPIRE authoring system. The purpose was to improve decision making skills by providing scenario-based training using actual data and plantation conditions. Users could open the tutor via a menu item in the MIS. The tutor allowed users to select problems to work on, enter the solutions to those problems and obtain feedback on the correctness of their solutions. They could exit at any time and resume other activities

within the MIS. Figure 2.3 shows the high-level architecture of DM-Tutor.

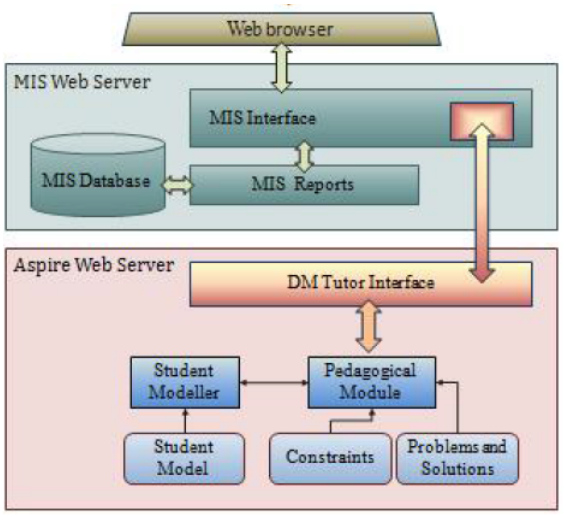

Figure 2.3: DM-Tutor Architecture [Amalathas et al., 2012]

Westerfield et al. [2013] developed a Motherboard Assembly Tutor (MAT) to help novice users learn how to assemble a computer motherboard. The MAT comprised an Augmented Reality (AR) head-mounted user interface, a procedural CBT developed in ASPIRE and a communication module to transfer information between the other two components. The CBT determined what problems and feedback were presented to the user via the AR user interface and the AR user interface provided information about user actions to the CBT. A study comparing the performance of the MAT with traditional AR computer aided training indicated that the presence of the ITS resulted in an improvement to learning outcomes. Figure 2.4 shows a high-level view of the architecture of MAT.

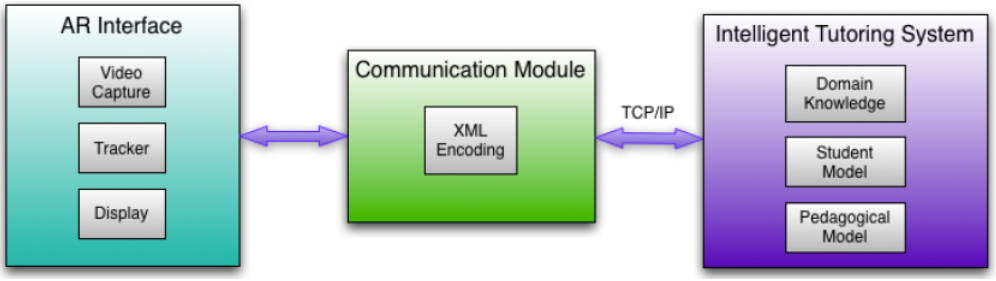

Figure 2.4: MAT Architecture [Westerfield et al., 2013]

Some aspects of our research will be similar to those in the previous two significant projects. Chreos Tutor will also be a CBT, developed using the ASPIRE authoring system. Amalathas et al. [2011] developed DM-Tutor and embedded it into an existing MIS to help users acquire decision making skills in oil palm plantation management. Westerfield et al. [2015] developed MAT to help users develop computer motherboard assembly skills. Chreos Tutor will be embedded into Chreos (see Section 2.4), which is an existing business software system, to assist users to successfully complete realistic data input tasks. Users of DM-Tutor entered task solutions directly into the CBT. Figure 2.5 shows the student interface of DM-Tutor for a fertilizer analysis task. This approach is not suitable for data input tasks. When learning data input skills users need to practise on the actual screens, rather than providing task solutions to the tutor in some other format. So, Chreos Tutor will operate in a similar manner to MAT, with the Chreos application obtaining problems and feedback from the CBT and providing information on user actions to the CBT via remote procedure calls. However the application component of MAT is an AR prototype for learning how to assemble hardware components on a computer motherboard. This is significantly different to the application components of both Chreos Tutor and DM-Tutor, which are existing workplace systems.

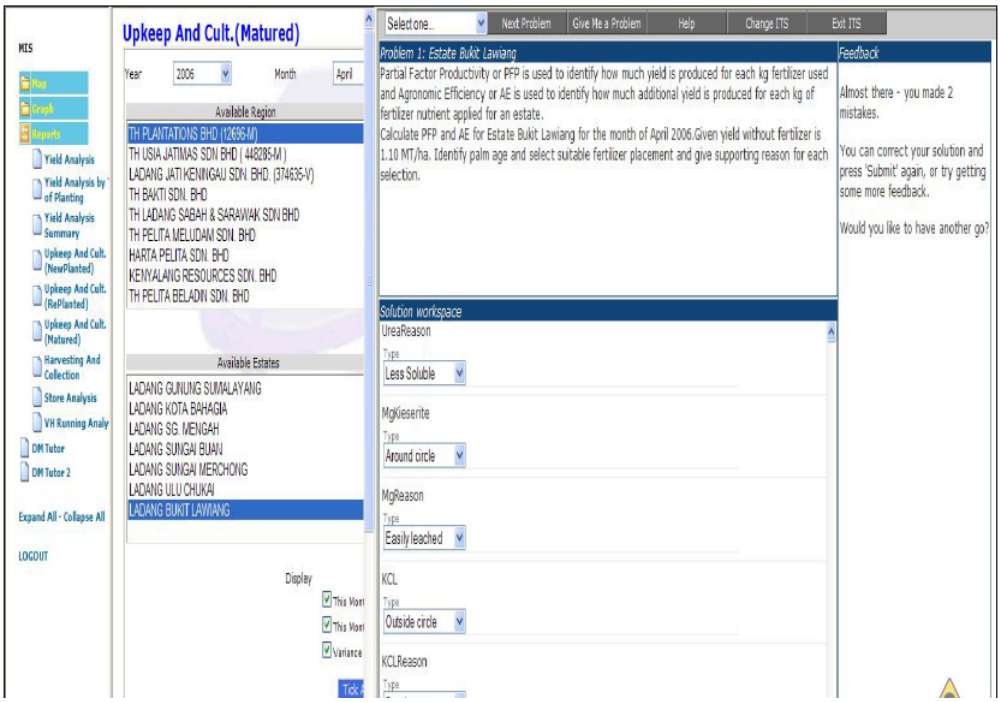

Figure 2.5: DM-Tutor Interface inside the MIS for Fertilizer Analysis Task [Amalathas et al., 2012]

2.4 Chreos Business Software

Chreos is a modular, integrated business system[1]. Modules include Point of Sale, Clients (or Debtors), Creditors, Stock (or Inventory) and General Ledger. These modules are integrated where relevant in order to minimize duplication of data input and maintain data consistency. The most commonly used modules are Stock and Clients. The Stock module provides a business with the functionality to manage the products and services it is buying and selling. The Clients module enables a business to enter and keep track of data relating to its customers or clients. The processes for entering transactions and viewing data are reasonably consistent throughout Chreos, so that knowledge acquired in one module is applicable in other modules.

Chreos implements double entry bookkeeping principles for all financial transactions. This can be implemented explicitly, where the user enters both

[1] http://www.chreos.com

sides of the transaction in a screen. However, with most screens users enter the minimal amount of data. Chreos then carries out any necessary calculations and generates all the appropriate bookkeeping entries. Figure 2.6 shows a Debtor Journal where users select the two clients being affected by the journal, but only enter the amount once from the perspective of the source client.

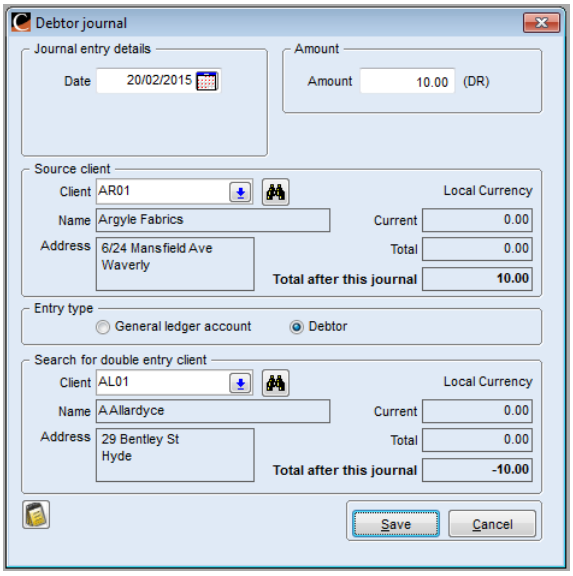

Figure 2.6: Debtor Journal Entry

New Chreos Service Packs (SP) are released on a regular basis, usually at a rate of 1 to 2 per year. Most Chreos users are currently running SP51, with SP52 being in development. The software is written in Delphi and runs on a Microsoft Windows operating system. It uses Client-Server architecture and the Firebird relational database for data storage.

Wild Software Ltd, the developers of Chreos, provide training and support to all users. Training of new users often incorporates human tutoring by one or more support personnel. Training sessions can take place at the business premises. Remote training is also an option, where support staff can see the desktop of the user and talk them through the process via telephone. Where possible the training will include the completion of real business tasks, so that the users are 'learning by doing' in a supervised environment. Each client of Chreos can also set up a 'Practice Company' which is either a copy

of their current database or of an earlier backup. This enables users to try out various tasks, without impacting live data. Beyond that, there are some training videos and a range of web-based help documentation.

Increasing the number of options available in a software system increases the learning difficulties for novice users. Chreos generally offers multiple ways of carrying out business processes. This allows clients to select the method that fits best with the way their business operates. It also increases the quantity and complexity of screens. An ITS can be structured so that users can learn features or task types incrementally, starting with the basic options.

The background and attitudes of new users of software can affect the learning experience. The small size of the Chreos user base limits the chances of a new user having previous Chreos experience. A new user can be an existing employee of a business that decides to install Chreos, or a new employee of a business already using Chreos. In the first case, there are usually multiple people having to learn a new system, with at least some of them perceiving that it has advantages over the previous system. In the second case, there is a single new user who may have preconceived ideas of how Chreos should behave from previous systems. An ITS that would allow users to practice real world tasks in the actual Chreos environment at their convenience would be a valuable training tool in both situations.

Chapter III

Chreos Tutor Design

In this chapter we look at the reasons particular types of tasks were selected for Chreos Tutor, how they were modelled in a constraint-based tutor developed using the ASPIRE authoring system, the design of the user interface and the results of a pilot study designed to evaluate the usability of the tutor.

3.1 Task Selection

Chreos already breaks business processes down into tasks, so for ease of learning Chreos Tutor will adopt the same definition. A task will only involve a single Chreos screen. These terms may be used interchangeably throughout this chapter.

The Clients and Stock modules are the two most commonly used Chreos modules. The Stock (or Inventory) module provides a business with the functionality to manage the products and services it is buying and selling. The tasks in this module tend to be internal and provide important services to other modules, such as Clients. One example would be the addition of new stock items that are going to be purchased from a creditor and later sold to clients. Another would be the entry of a physical stocktake into the system to correct the recorded quantities, giving a more accurate picture of stock availability for client orders. The Clients (or Debtors) module enables a business to enter and keep track of data relating to its customers or clients. Most tasks in this module are external in that the input is generated by clients or the output is provided to clients. Figure 3.1 shows the main Chreos menu screen with the Clients sub-menu open. Each item in this sub-menu opens a screen or a further sub-menu. The selected 'Journal' item opens the debtor

journal screen. The processes for entering transactions and viewing data are reasonably consistent throughout Chreos, so that knowledge acquired in one module is often applicable in other modules.

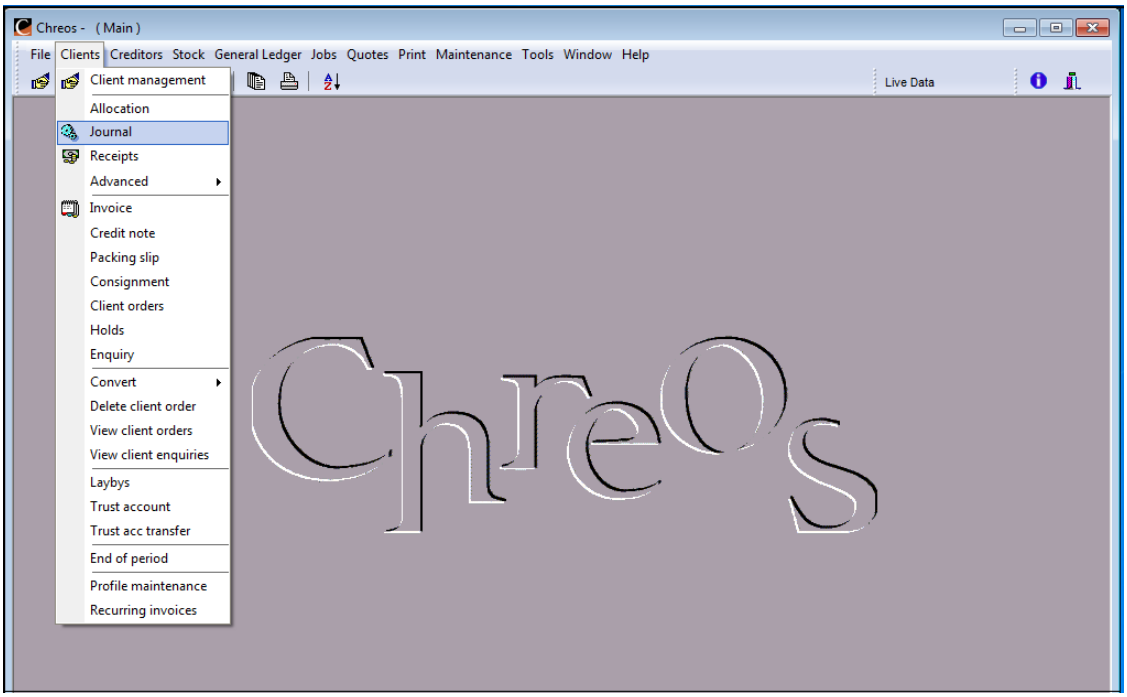

Figure 3.1: Chreos main menu with Clients sub-menu selected

The output from external transactions are carefully scrutinised by the parties that they affect, so they are often aware of any inaccuracies. Inaccuracy in internal transactions can often be corrected by the business without any affect on external parties. Therefore it is more critical that users entering external transactions learn how to do this correctly. Using this criteria initial task selection for Chreos Tutor comes from the Clients rather than the Stock module.

There are not many fields in Chreos screens that need to be typed in by the user as free text. Some fields, such as dates, have default values that appear when the screen opens. These only need to be changed if the value is not appropriate. Other fields, such as clients and stock items, must be selected from values that already exist. Some Chreos screens also have non-input fields that display information deemed helpful for the task being

completed.

3.1.1 Debtor Journal

Debtor journals are used to make financial adjustments to debtor balances. The debtor journal screen has two modes or 'Entry types'. The transaction date, amount and 'Source client' fields are common to both modes. The balance of the 'Source client' will be adjusted by the value in the amount field. If the amount is positive, the balance will be increased and if it is negative the balance will be decreased.

Figure 3.2 shows the screen in 'Debtor' mode, where a second client (Double entry client) is selected. The balance of this client will move in the opposite direction to the 'Source client' and by the same amount. This type of journal is typically used when a payment from Debtor A is incorrectly receipted to Debtor B in Chreos.

Figure 3.3 shows the screen in 'General ledger account' mode, where the General ledger account affected by the journal is selected, along with the 'GST type' (Goods and Services Tax type) of this account for this journal. This type of journal can be used to deal with a range of situations such as: a receipt entered into Chreos for an incorrect value, writing off a small debtor balance when the debtor is no longer a client, writing off a balance that has become a bad debt, a receipt entered into Chreos that is subsequently reversed by the bank due to a lack of funds.

This screen was the first to be modelled in Chreos Tutor. It is a standalone, single page screen with a small number of simple input fields. This makes it easier to model and easier to extract user input. I am very familiar with the screen as I helped a number of clients learn how to use it while involved in customer support at Chreos. This made me very aware that users had difficulty using the screen correctly. They need to decide whether the amount field should be positive or negative, which client should be the 'Source client' when in 'Debtor' mode, which account to select when in 'General ledger account' mode and what 'GST type' is applicable to that account for this particular journal. There is a similar screen in the Creditors module, so the knowledge of how to use this screen would be transferable.

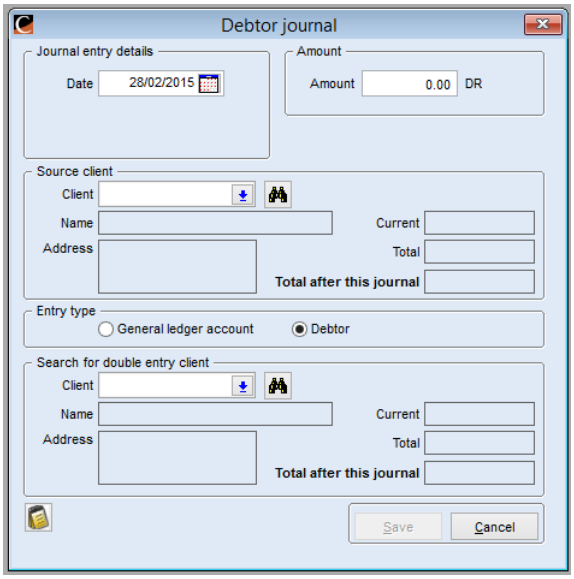

Figure 3.2: Client Journal screen in Debtor mode

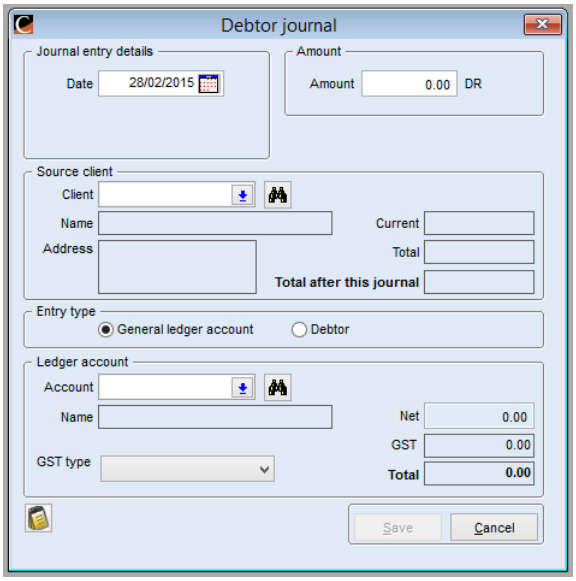

Figure 3.3: Client Journal screen in General Ledger mode

3.1.2 Client Orders

The client orders screen is used to enter orders received from clients. Once an order is entered it can be converted to a packing slip or invoice at the appropriate time.

Figure 3.4 shows how the client orders screen appears when it opens. In the top left section of the screen, the client who placed the order must be selected. This screen is used for other tasks including packing slips and invoices, so the 'Activity' field is used to specify the appropriate option. The top right section changes with this selection. If this screen is opened via the client orders sub menu item, the activity will default to 'Order'. If a different sub menu item is used, then the default value will not be appropriate. The 'Order' option must then be selected from the options in the drop down box.

The next section of the order requires a transaction date, an order number if provided, a date by which the client requires the stock items to be delivered if specified and the details of the address to which the items are to be delivered. The transaction date defaults to the computer date and the 'Deliver by' date defaults to 1 day after that. The 'Delivery address' defaults to 'Delivery', with the standard delivery address details appearing in the box underneath. It is possible for a client to have multiple delivery addresses. It is also possible that the client may want to collect the goods, in which case the 'Delivery address' should have the 'None' option selected. The 'Postal' option allows the items to be sent to the client's normal postal address and the 'Custom' option allows usage of a previously specified custom address or entry of a new one.

In the top right section the 'Quote' checkbox indicates whether prices and discount specified in the order are fixed. The 'Can split delivery' checkbox indicates whether the client is happy for the order to be part-delivered or requires all items delivered together. Both checkboxes have a default value for each client. The 'Not before' date indicates a date before which the client does not want the items delivered. This date defaults to the transaction date. The remainder of the fields in this section are specific to orders received in a retail environment or to how particular businesses operate and so are not suitable for generic order entry.

The middle section of the screen is the item grid listing the items to be included in the order. These items are chosen from existing stock items via the 'Select item' field on the bottom left of the screen. A selected item will appear in the grid with a quantity of 1 and at the standard system price or 'Unit amount'. The buttons on the left just below the item grid allow users to edit the quantity and price of items, change the order of the items and remove items. Freight cannot be applied to client orders, but discount can be. The 'Discount' button allows a user to enter a percentage or dollar discount, which then appears as a row in the item grid. This allows the 'Total' of the order to be the sum of the 'Total incl' column of all items in the item grid.

This screen was the second selected for Chreos Tutor. It is one of the most commonly used screens by new users of Chreos. Once a user learns how to enter client orders correctly, they should be able to transfer those skills easily to the other tasks that use the same screen. The client order screen also contains a grid. Grids are a reasonably common component in Chreos so it is important to be able to successfully model them in Chreos Tutor.

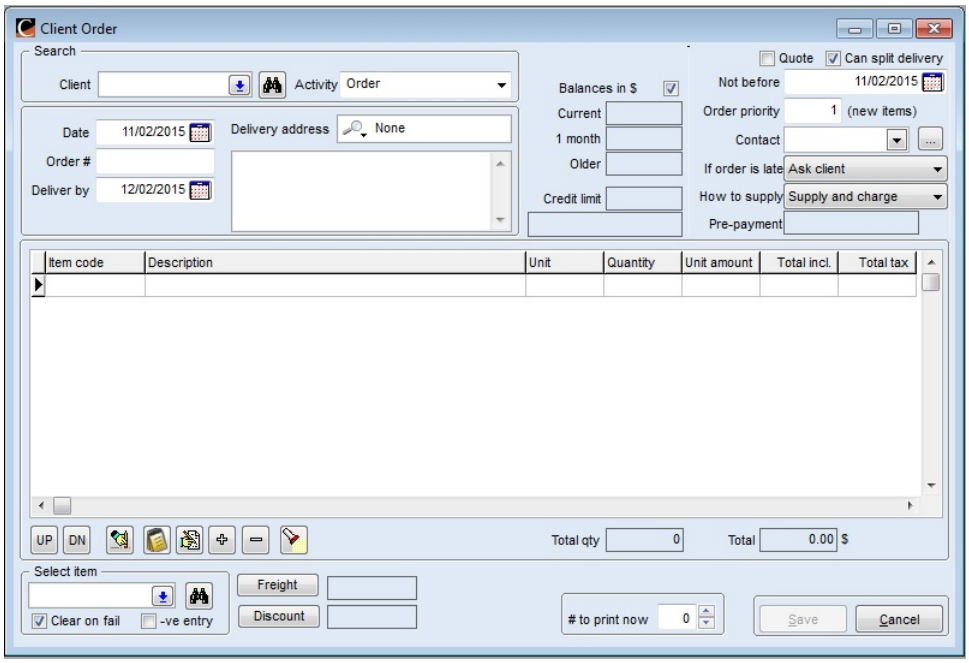

Figure 3.4: Client Orders Screen

3.2 Modelling the Domains in ASPIRE

This section describes the modeling of the debtor journal and client orders screens as separate domains in ASPIRE-Author.

3.2.1 Debtor Journal

The first phase of the authoring process requires the author to indicate whether the instructional task is procedural or non-procedural. If it is procedural, then the author must specify the generic problem-solving steps required to complete tasks within the domain. With most Chreos input screens, the order in which fields are entered is not critical. Generally users start entering fields at the top left and work their way down and/or to the right in a logical manner. Each screen has a tab order which conforms to this kind of progression, but users are free to move to fields via their mouse. The critical thing is that when the user clicks the 'Save' button, everything they have entered into the screen is correct. This is the case with the debtor journal screen and therefore it suits a non-procedural approach.

The next phase is to model important concepts in the domain, along with their properties and any relationships between them. Authors need to determine which concepts in the domain are relevant to tasks users will complete using the tutor and which can be excluded from the model. Figure 3.5 shows the debtor journal domain ontology. There is a single parent concept which is an 'Input Field'. It is an abstract concept with a single property, called a 'Value', representing the value a user enters into an input field in the debtor journal screen. There are seven components in the debtor journal screen that need to be correctly filled out. Each of these is represented in the domain ontology by a sub-concept underneath 'Input Field'. The name of these sub-concepts is the name of the relevant component in the debtor journal screen. Each sub-concept inherits the properties of its parent, so no additional properties are necessary. Figure 3.6 shows which screen label corresponds to each component name.

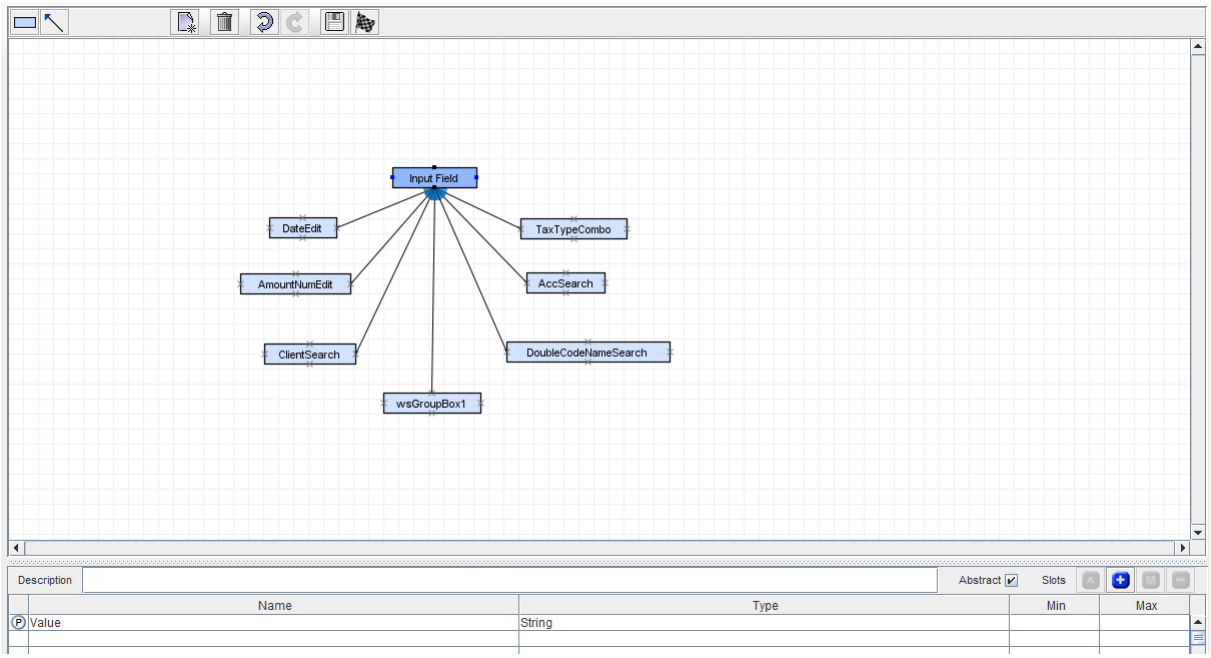

Figure 3.5: Debtor Journal ontology in ASPIRE

Screen Label	Component Name
Date	DateEdit
Amount	AmountNumEdit
Source client: Client	ClientSearch
Entry type	wsGroupBox1
Double entry client: Client	DoubleCodeNameSearch
Account	AccSearch
GST type	TaxTypeCombo

Figure 3.6: Debtor Journal map of screen label to component name

When the domain ontology is completed, the author moves on to designing the problem and solution structures. With a non-procedural domain, the problem structure can include a general statement relevant to all problems as well as a problem-specific statement. The solution structure contains a list of solution components. Each of these components has a label, allowed concept types from the domain ontology and an element count to indicate the number of elements it can contain. Figure 3.7 shows the problem and solution representation for debtor journal. The debtor journal domain only uses a problem-specific statement. The first four components of the solution structure have an element count equal to 'Exactly 1', which means that these components are mandatory for every problem solution. The last three components have an element count of '0 or 1', which means a problem solution may or may not contain these components. The 'wsGroupBox1' component contains the 'Entry type' of the task, which is either 'Debtor' or 'General ledger account'. If the 'Entry type' is 'Debtor', then the solution should contain a 'DoubleCodeNameSearch' component. Alternatively if the 'Entry type' is 'General ledger account' then the solution should contain the 'AccSearch' and 'TaxTypeCombo' components.

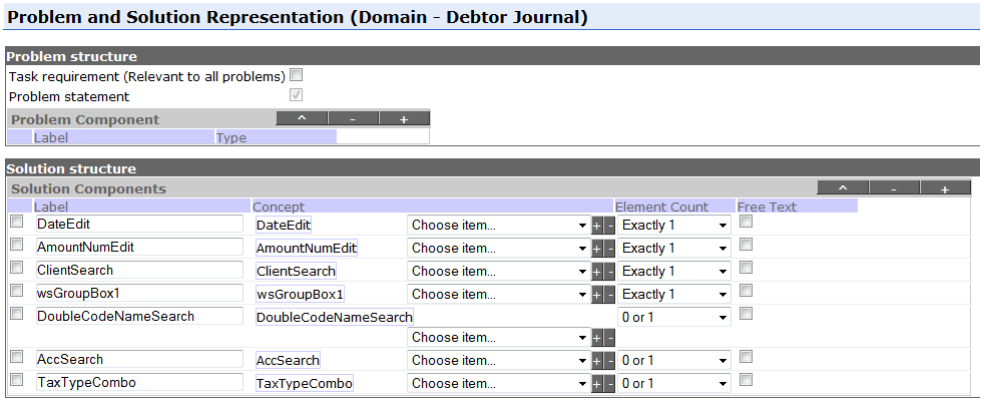

Figure 3.7: Debtor Journal solution structure in ASPIRE

The next phase is the design of the student interface. ASPIRE-Author automatically generates an HTML interface from the problem and solution structure. The author can choose to use this default interface or upload one or more applets. Chreos Tutor provides a student interface inside Chreos so does

not use either of these interface options. The student interface communicates with the CBT via XML remote procedure calls. This is discussed further in Section 3.3.

The author then needs to specify problems for students to attempt, along with one or more solutions for each problem. Problems and solutions conform to the structure specified earlier, but the content is different. Figure 3.8 shows the problem statement and solution for Problem 1.

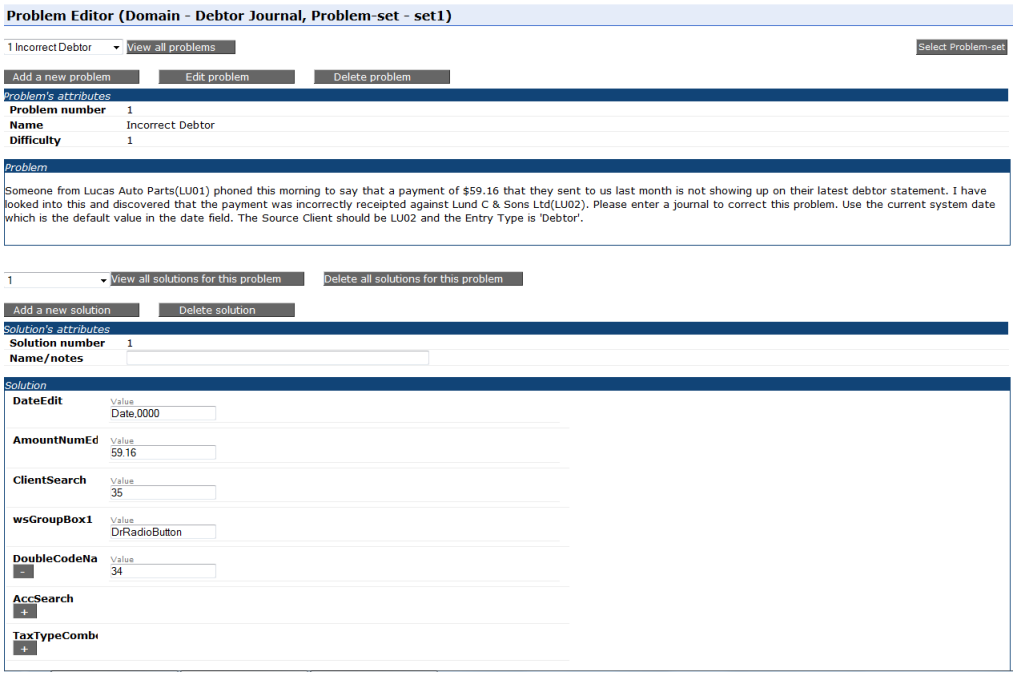

Figure 3.8: Debtor Journal Problem 1

Some values in the solution do not appear to be derived from the task description. The task description indicates that the 'Source Client' is 'Lund C & Sons Ltd(LU02)', which is the name of the client plus the client code. Either of these can be used to select a client in the debtor journal screen. However the solution specifies that the 'ClientSearch' component should have a value of '35'. This is the Chreos system generated identifier unique to this particular client. To ensure that the correct client has been selected, Chreos Tutor incorporates the unique identifier into the solution rather than the name or code. When the student solution is extracted from the debtor journal screen, the entered client code or name will be converted to the

appropriate Chreos system generated identifier unique to that client. The same process occurs with the 'DoubleCodeNameSearch' component. The value of the 'wsGroupBox1' solution component is the name of the radio button that should be selected. 'DrRadioButton' corresponds to an 'Entry type' of 'Debtor'.

A total of twelve tasks have been defined for the debtor journal domain. All task descriptions refer to and are consistent with the tutoring database, which is an amended version of a database used for Chreos sales demonstrations. In a normal Chreos entity, the database is updated when input is processed. This cannot happen with the tutoring database, because the ITS tasks are fixed and can be completed by multiple users at different points in time. The database needs to remain in the state that existed when the tasks and their solutions were originally determined. All Chreos input screens have a 'Save' button and normally when this is clicked, the database is updated. The 'Save' button on screens relevant to Chreos Tutor tasks are hijacked by the tutor to instead send the task solution to ASPIRE and return feedback to the student interface without modifying the database.

Dates are important pieces of data in Chreos. This can be the date or month a transaction belongs to, as well as the date the transaction is entered. The first type of date is usually selected by the user, whereas the second type comes from the computer date. Some modules in Chreos have their own system date, which allows those modules to be in a different month to other modules and in an earlier month than the real world. This allows users to enter transactions into the appropriate month in Chreos even if that month is finished in the real world. The Clients module has its own 'current system date'. Transaction dates in Chreos screens usually have a default value, which can be the 'current system date' for the module or alternatively the computer date. Sometimes this is fixed by the system due to the nature of the transaction, but sometimes it can be user specified. For Chreos Tutor purposes the debtor journal transaction date defaults to the 'current system date' for the Clients module.

It is important for learning purposes to keep dates reasonably current in Chreos Tutor, as that is normally the situation in real Chreos entities. Therefore dates included in task descriptions and problem solutions need to

be future-proofed to avoid the need for constant updating as time rolls on. Our solution is to exclude any mention of a year and to look at the month in terms of how distant it is from the current system month or the computer date month. To cater for varying screen requirements the day component of the date can represent two different options. In the first option it represents an actual day in the month such as the current, 1st, 20th or last day. In the second option it represents the number of days ahead of the day component of the default date, such as 7 or 14. In this debtor journal problem the 'Date' part of 'Date,0000' means the selected date is of the first type, the first two zeros mean that the day is the current day and the second two zeros mean that the month is the current month. An example of the other type of date is presented later for a client orders problem.

Once all problems and solutions have been entered, the author can generate constraints. ASPIRE-Author generates syntax constraints from the domain ontology, solution structure and general domain information. These constraints check whether the student solution adheres to all the rules specified within these areas. Semantic constraints are generated from the problems and their solutions. They check that a student's solution is valid for the problem being attempted. In the debtor journal domain, one syntax constraint would check whether the user has entered a date and that the entered value is correctly formatted as a string. If this is not the case, the syntax constraint is violated and ASPIRE-Author returns a feedback message indicating that this has happened. The equivalent semantic constraint would check whether a syntactically correct date value matches the value in the problem solution. If not, the semantic constraint is violated and a different feedback message is generated. Each constraint has associated default feedback messages generated from a template. These default messages are not intended to be provided to students as they assume familiarity with the domain ontology. It is left to the author to amend these messages to something more appropriate. In this domain the default messages refer to the concept or component names such as 'wsGroupBox1', which are not helpful to the user. At a minimum these messages need to be altered so that they refer to the screen labels such as 'Entry type' instead. Figure 3.9 shows the semantic constraint that checks whether the 'Entry type' has the correct value and the

altered feedback messages for users.

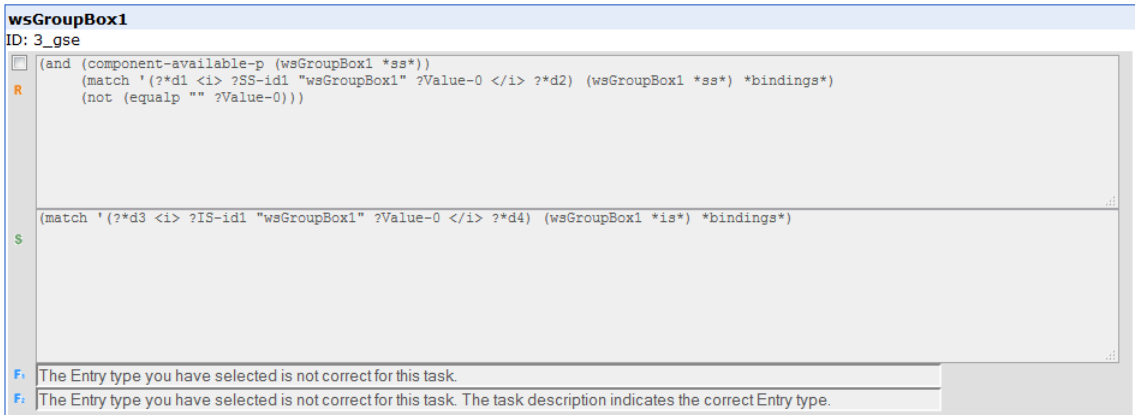

Figure 3.9: Debtor Journal Semantic Constraint

Twenty constraints were generated by ASPIRE for the debtor journal domain, comprising seven syntax and thirteen semantic. Two of the semantic constraints were removed and replaced with four author-written constraints. These four constraints make it possible to provide feedback on errors in the student solution for the 'Source' and 'Double Entry' clients, in terms of whether the client is mentioned in the task description or not. This allows more specific feedback for tasks involving two clients. It is possible to indicate that the error is due to the 'Source' or 'Double Entry' clients being swapped.

The final phase is the deployment to ASPIRE-Tutor, so that the tutor can be accessed by students. This is an automated process during which various checks on the consistency and completeness of the domain are carried out.

3.2.2 Client Orders

Modelling the client orders screen in ASPIRE is a very similar process to modelling the debtor journal screen. This section concentrates on describing parts of the model that are different.

The client orders domain suits a non-procedural approach, as the order in which the values are entered is not important. All values just need to be correct before the 'Save' button is clicked.

Figure 3.10 shows the client orders domain ontology. This domain also has an abstract 'Input Field' concept, containing a single 'Value' property.

There are eleven simple components in the Client Journal screen that are represented as sub-concepts of 'Input Field'. Figure 3.11 shows which screen label corresponds to each component name. There are some other simple components that have been excluded from the domain model as they are not sufficiently generic for Chreos Tutor. The client orders screen also contains an input grid, listing the items included in the order. This is represented as 'InvoiceGrid' in the ontology, which is the name of the grid component in the client orders screen. Each item forms a row in the grid, so the 'InvoiceGrid' concept has a 'Rows' property related to the 'Row' concept. The 'Row' concept has three properties representing the fields critical in determining if the item details are correct. Those fields are the 'Itemref', the quantity and the unit price of the item. The 'Itemref' is a system generated identifier unique to an item.

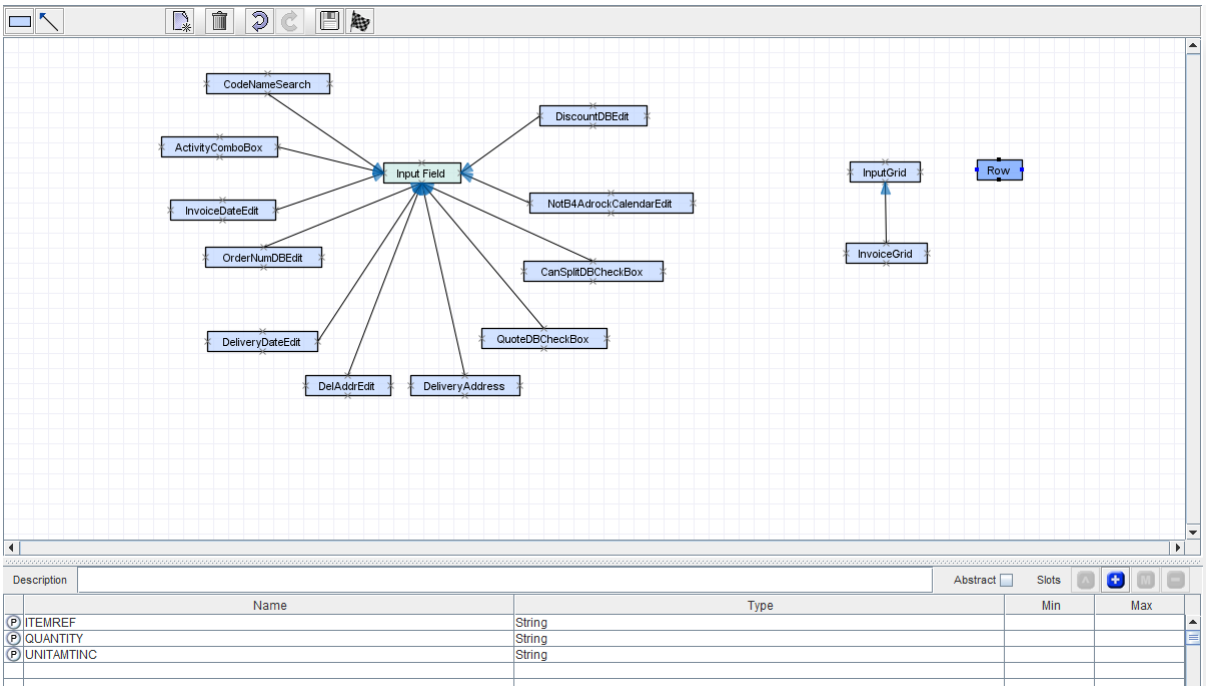

Figure 3.10: Client Orders ontology in ASPIRE

Screen Label	Component Name
Client	CodeNameSearch
Activity	ActivityComboBox
Date	InvoiceDateEdit
Order#	OrderNumDBEdit
Deliver by	DeliveryDateEdit
Delivery address: Type	DelAddrEdit
Delivery address: Details	DeliveryAddress
Quote	QuoteDBCheckBox
Can split delivery	CanSplitDBCheckBox
Not before	NotB4AdrockCalendarEdit
Discount	DiscountDBEdit

Figure 3.11: Client Orders map of screen label to component name

Figure 3.12 shows the problem and solution representation for client orders. In total there are twelve solution components, eight of them mandatory. Three components are optional. The order number (*OrderNumDBEdit*) is optional and is only entered if the client provides it. If the client intends to pick up the order, then the type of the delivery address (*DelAddrEdit*) will be 'None' and there will not be any delivery address details (*DeliveryAddress*). Discount (*DiscountDBEdit*) is also optional and only applies in special circumstances. The final component is the 'InvoiceGrid', with a different type of element count. This component must have 'At least 1' element in each problem solution. Client orders must include one or more items.

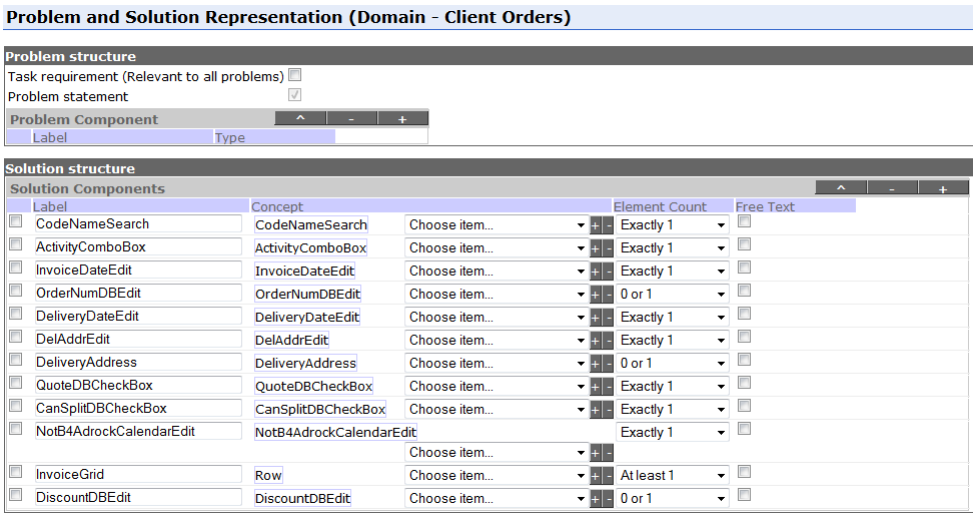

Figure 3.12: Client orders solution structure in ASPIRE

A total of sixteen tasks have been defined for the client orders domain. Figure 3.13 shows part of the problem statement and part of the solution for Problem 2. The client orders screen contains three date fields. For Chreos Tutor purposes, the client orders screen opens with the transaction date set to the computer date, the 'Deliver by' date set to the computer date plus 1 day and the 'Not Before' date equal to the transaction date. The transaction date solution is not visible, but the value is 'Date,0000'. This represents the computer date. In the 'DeliveryDateEdit' solution the 'Diff' part of 'Diff,0500' means the selected date is of the type that represents the number of days it is ahead of the computer date. The first two digits '05' indicate that this date should be five days ahead of the computer date. With this type of date the final two digits are always '00'. This approach correctly deals with five days ahead whether it is within the same month or crosses into the following month.

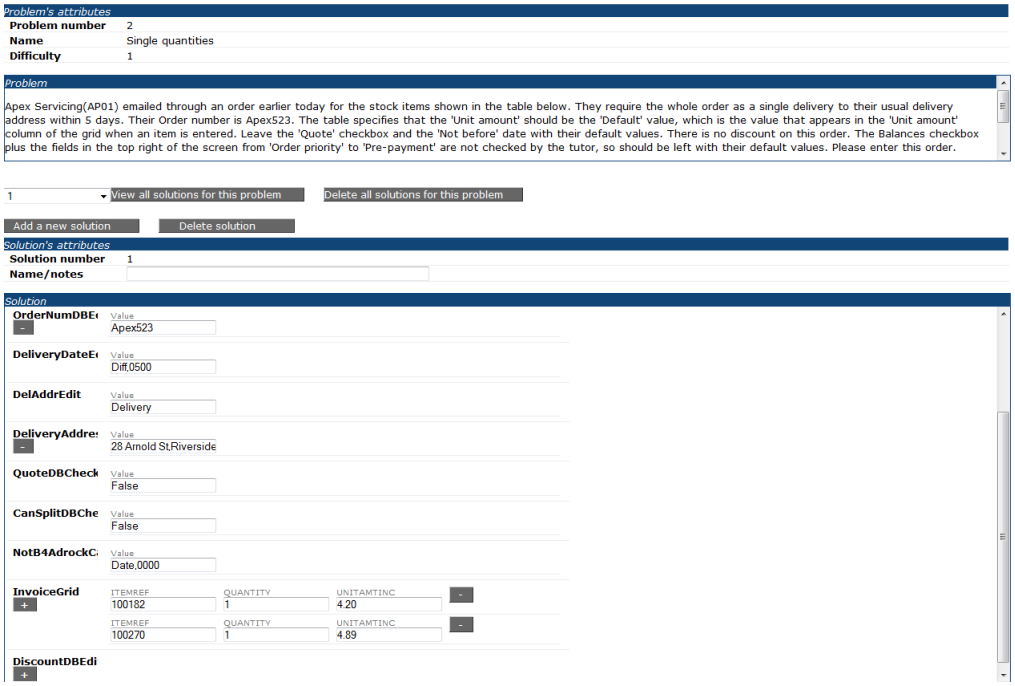

Figure 3.13: Client orders Problem 2

Thirty five constraints were generated by ASPIRE for the client orders domain, comprising sixteen syntax and nineteen semantic. The 'Invoice Grid' component accounts for seven of these, which are needed to ensure that the student solution contains the correct number of rows, that each row in the student solution matches a row in the ideal solution and that each row in the ideal solution matches a row in the student solution. Together these constraints check that the solutions are an exact match, without limiting the order in which items are entered.

3.3 Chreos Tutor Interface Design

The user interface is embedded into Chreos. The major part of the interface is the Chreos Tutor screen where users first choose a domain they wish to learn about. Once they select a task to complete from within that domain, the relevant task description is displayed. The other part of the interface is the existing Chreos screen in which they must complete that task. Feedback on their solution is displayed in that screen as well as in the Chreos Tutor

screen. The Chreos Tutor screen controls all interaction between the user and the CBT in both directions.

This section looks briefly at the architecture of Chreos Tutor, then at the Chreos Tutor user interface at various stages of the task solution process.

3.3.1 Chreos Tutor Architecture

ASPIRE-Tutor can be accessed via XML remote procedure calls. This allows a tutor to be integrated into an application and have a customised user interface appropriate for that application. The remote procedure calls are available for all the normal ASPIRE-Tutor functions.

Figure 3.14 shows a high-level view of the Chreos Tutor architecture. Chreos Tutor communicates with ASPIRE-Tutor over a TCP/IP network connection.

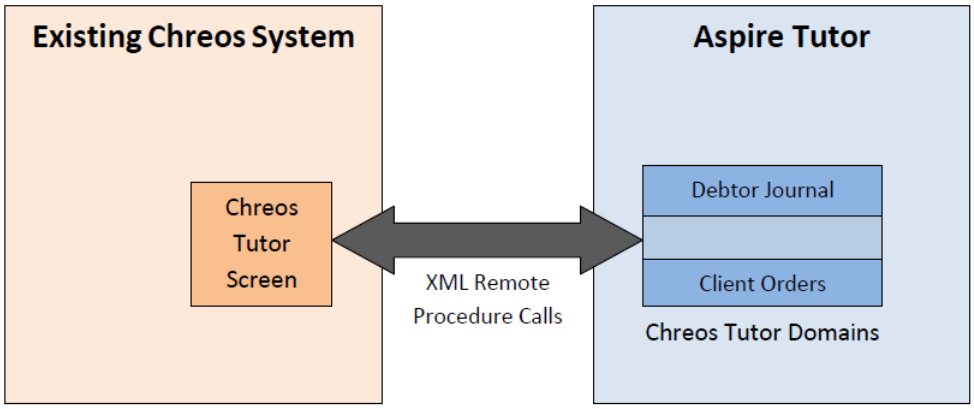

Figure 3.14: High level software architecture

3.3.2 Chreos Tutor Screen

Figure 3.15 shows the Chreos Tutor screen when it first opens. The screen contains some general information about the tutor.

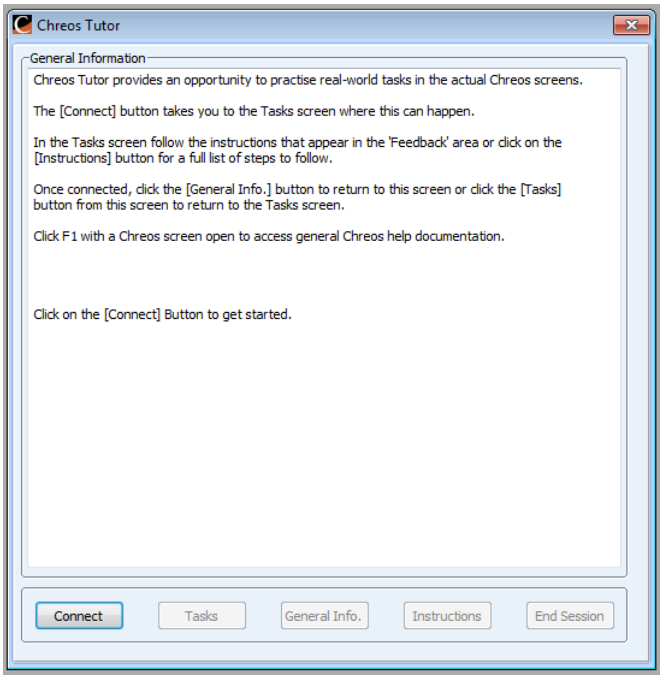

Figure 3.15: Chreos Tutor General Information Screen

Once a user connects to ASPIRE, the tutor switches to the main screen. From here users can select the type of task they want to learn and open up an additional screen giving them step by step instructions for using the tutor. Figure 3.16 shows the main Chreos Tutor screen with the Task Instructions screen open beside it. Appropriate instructional text also appears in the feedback area.

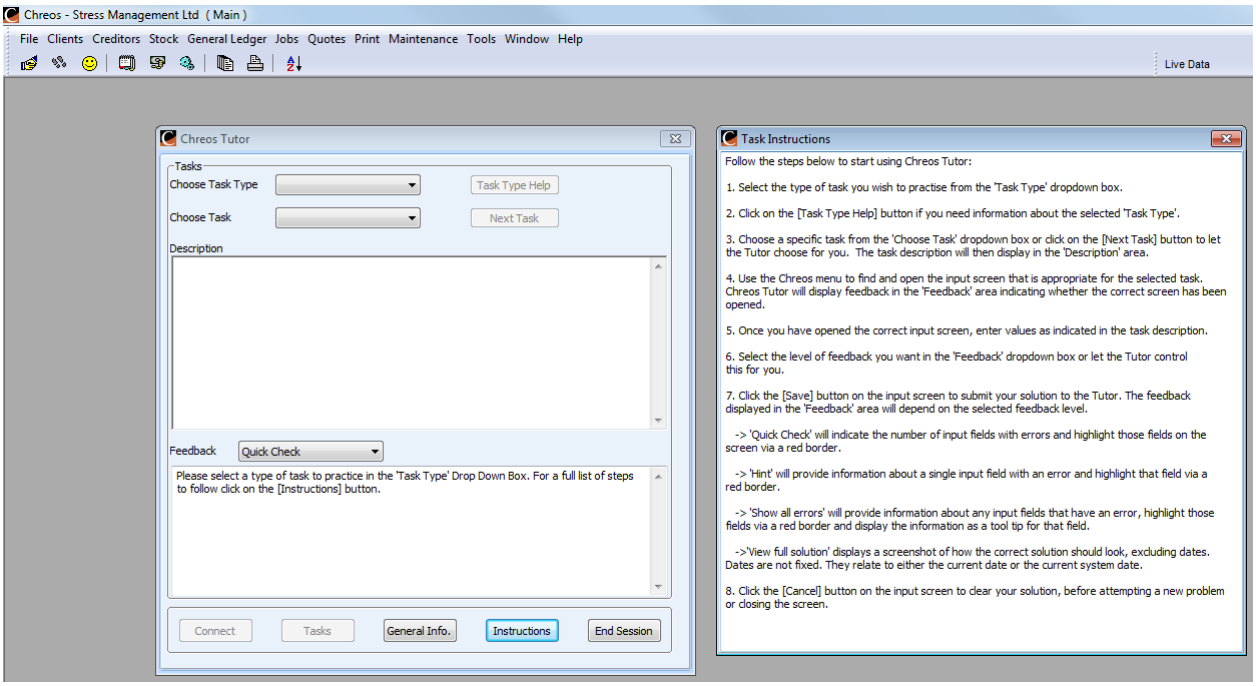

Figure 3.16: Chreos Tutor Task Instructions

Figure 3.17 shows the Chreos Tutor screen after the debtor journal task type has been selected and Figure 3.18 displays the screen after the user has chosen to attempt task 1. This is the same task that is used to illustrate the problem statement and solution in ASPIRE as seen in Figure 3.8. This task requires the debtor journal screen to be in 'Debtor' mode so that a payment incorrectly receipted to one client (LU02) can be journaled across to the correct client (LU01).

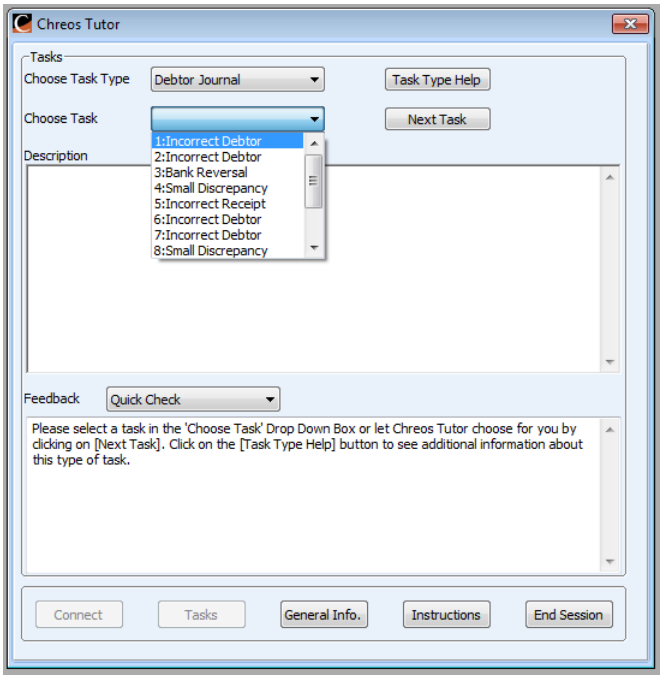

Figure 3.17: Chreos Tutor: Choosing a Debtor Journal task

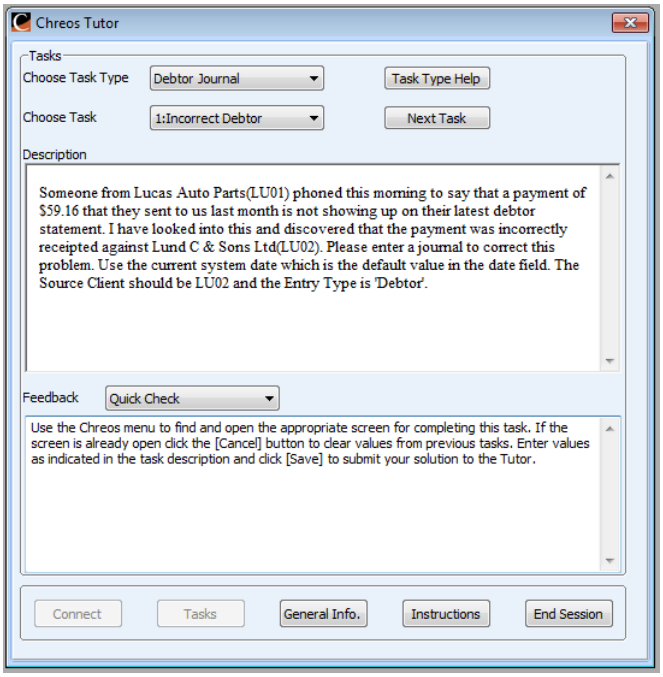

Figure 3.18: Chreos Tutor Debtor Journal Task 1

Users receive positive feedback when they have opened the correct Chreos input screen as can be seen in Figure 3.19.

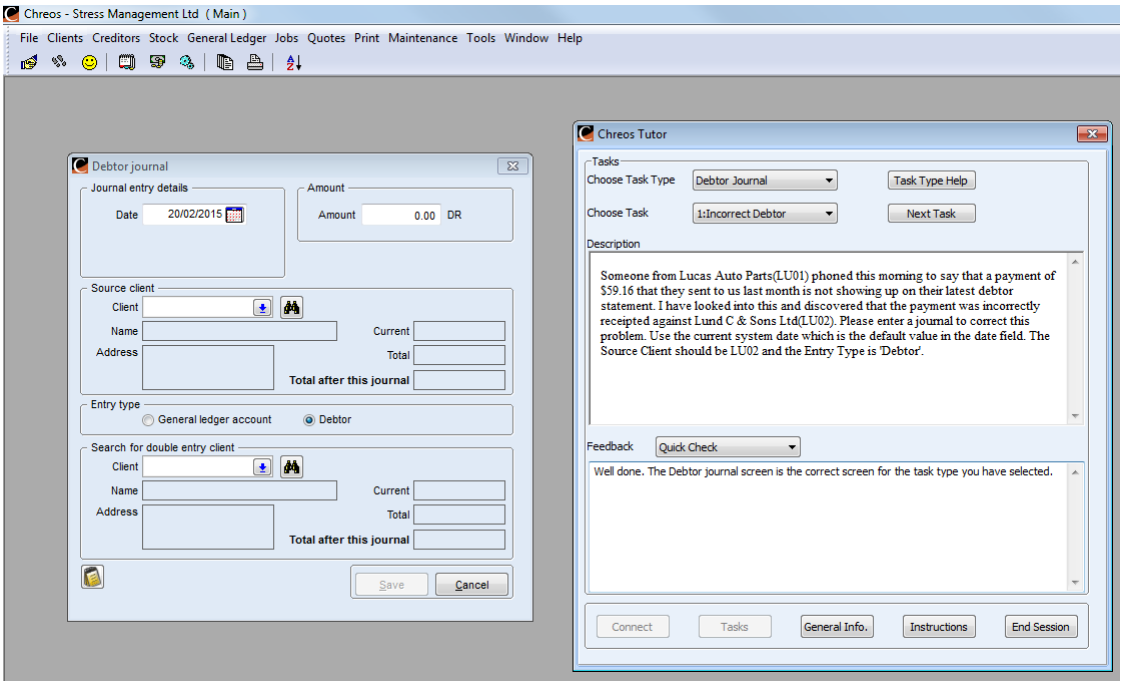

Figure 3.19: Chreos Tutor with Debtor Journal screen open

We will now switch to debtor journal task 4 to look at the different levels of feedback available to users when they submit their solution. The description of task 4 can be seen in Figures 3.20 to 3.22. This task requires the screen to be in 'General Ledger account' mode so that the small discrepancy in the account balance of a client (MC Loversidge) can be journaled to an appropriate account in the General Ledger (Rounding).

There are four graduated levels of feedback, with the fourth level being a screenshot of the ideal solution. Feedback starts out at the 'Quick Check' level when a task is selected. Figure 3.20 shows this level of feedback. Text in the feedback area indicates how many input fields have errors and those fields are highlighted with a red border in the input screen.

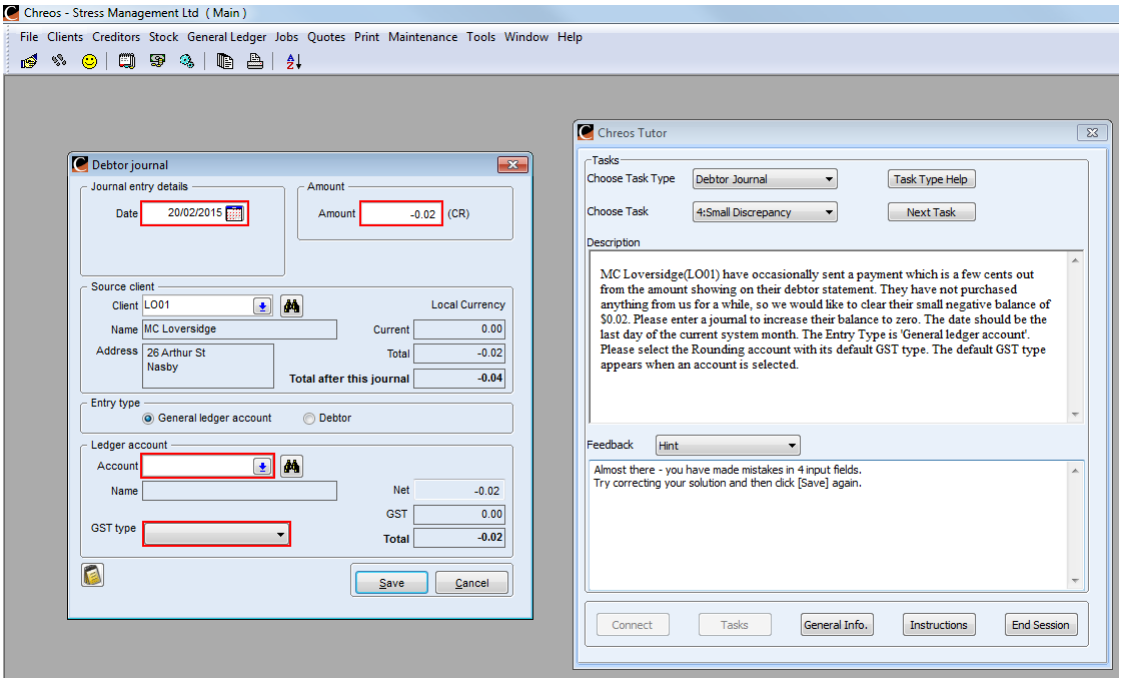

Figure 3.20: Debtor Journal Task 4 with Quick Check feedback level

Users submit their solution by clicking on the 'Save' button. This button has been hijacked so that it behaves like the 'Submit' button in typical ASPIRE ITSs. The level of feedback automatically increases each time the 'Save' button is clicked. Figure 3.21 shows the 'Hint' feedback level, which provides a hint about how to correct the error in one particular input field. This field is highlighted with a red border in the input screen.

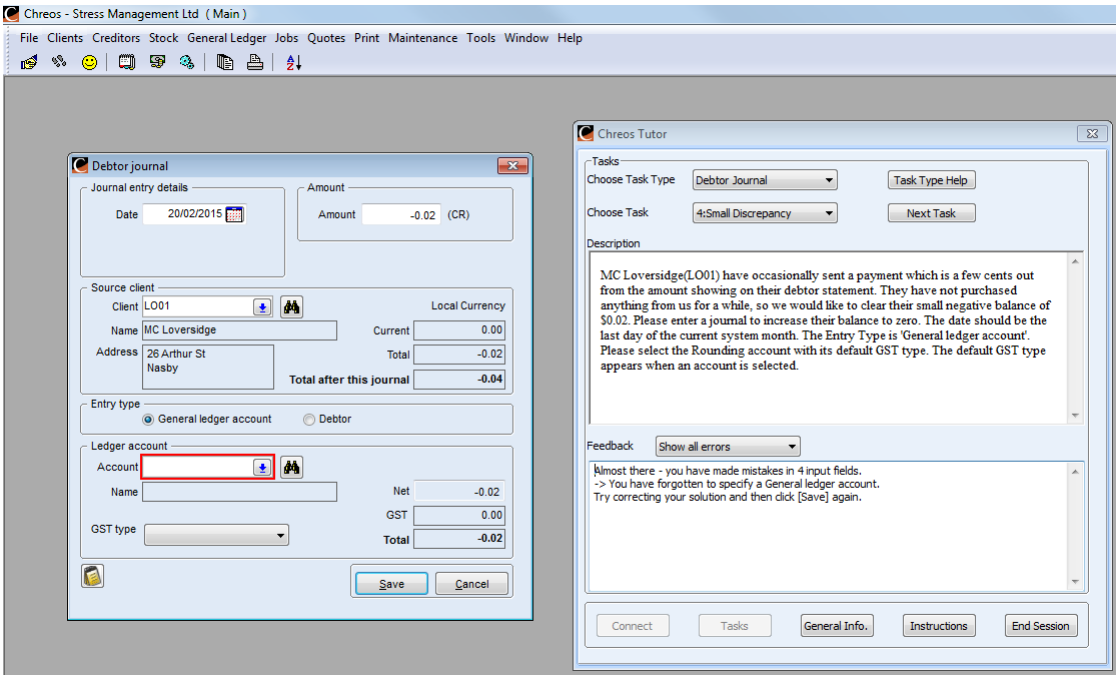

Figure 3.21: Debtor Journal Task 4 with Hint feedback level

The third level of feedback 'Show all errors' can be seen in Figure 3.22. A more detailed hint is given about how to correct each input field. All incorrect input fields are highlighted with a red border and when a user hovers their mouse over one of those fields, the corresponding detailed hint also shows as a tooltip. Feedback remains at this level until a new problem is selected or the user selects a different option.

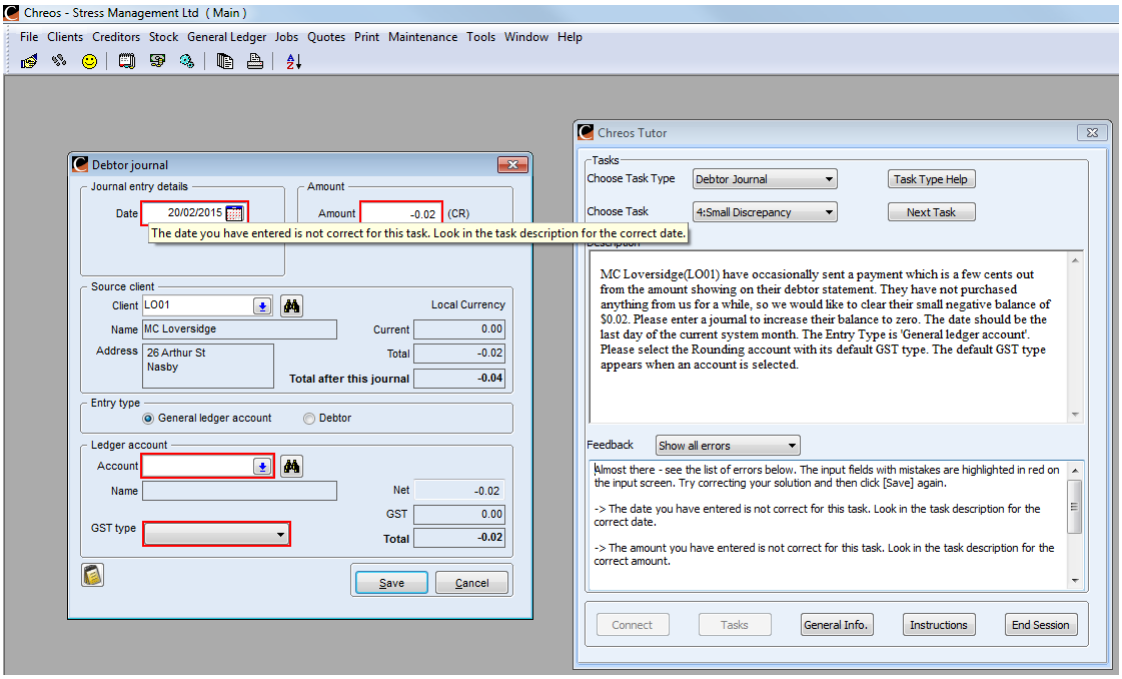

Figure 3.22: Debtor Journal Task 4 with Show All Errors feedback level

Users can choose to look at the full solution. This is a static screenshot containing the correct values, apart from the date fields. Figure 3.23 shows the full solution for task 4. The date field contains text similar to that in the task description. Once a task has been successfully completed users receive positive feedback as shown in Figure 3.24.

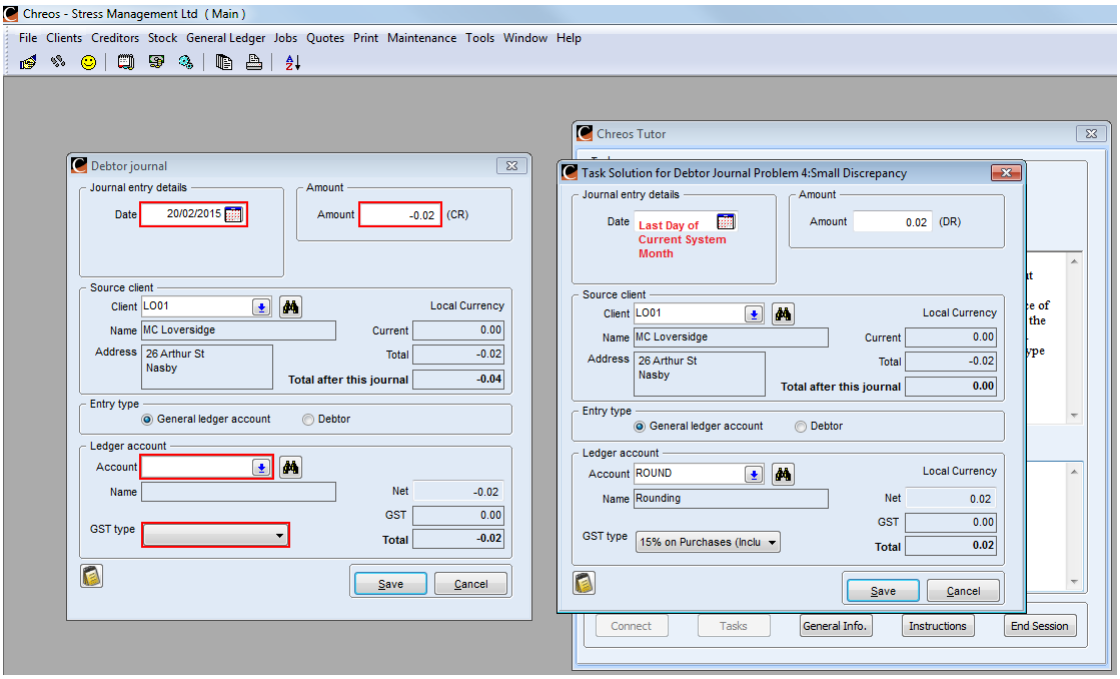

Figure 3.23: Debtor Journal Task 4 with View Full Solution feedback level

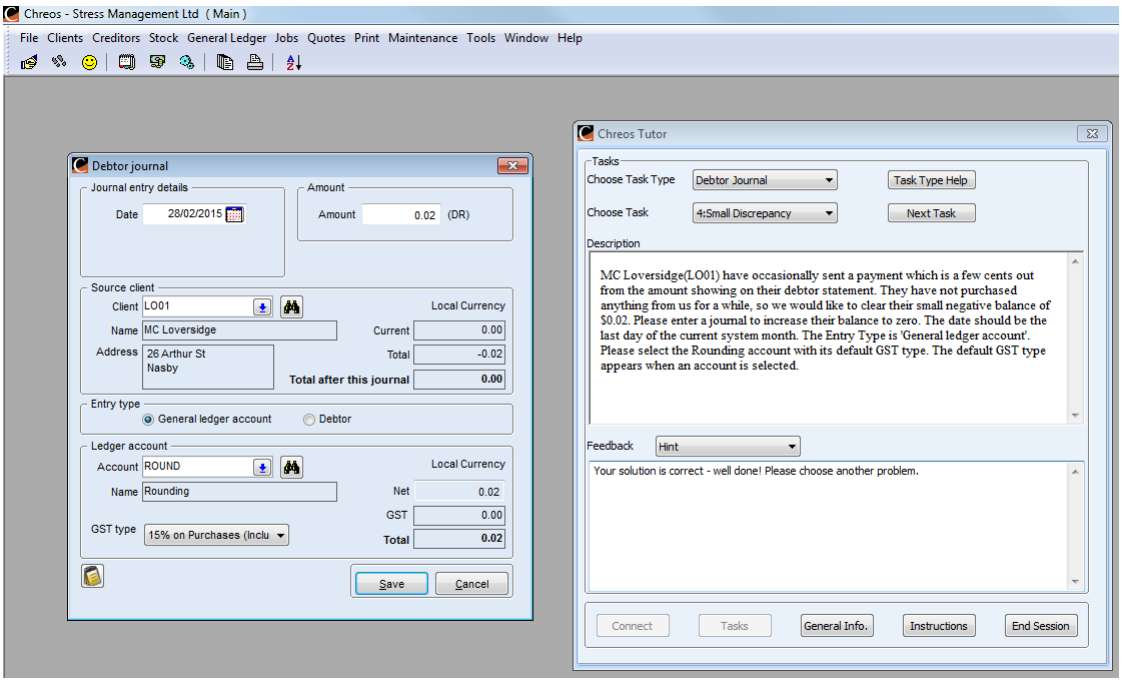

Figure 3.24: Debtor Journal Task 4 feedback when solution is correct

Client orders tasks have some additional graphic feedback provided for the 'InvoiceGrid' at the 'Show all errors' level. Any row that does not have a match in the ideal solution is highlighted with a red background. This is also done for duplicate correct rows, as no duplicates are included in any tasks. The other difference with the 'InvoiceGrid' is that more than one constraint can be violated by a student solution. All feedback messages from violated constraints are grouped together, rather than appearing as separate messages. Figure 3.25 shows the feedback for task 2 when one of the items in the order is not in the task description and one of the items in the task description is not in the order.

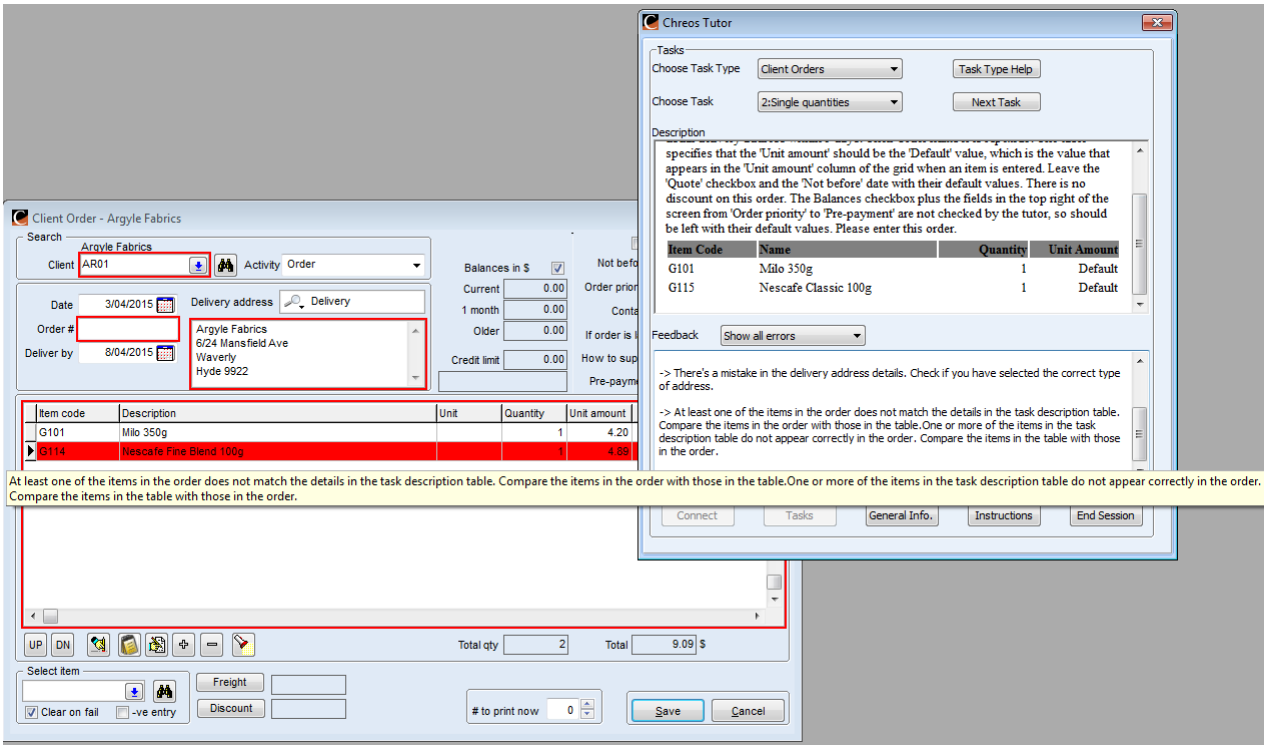

Figure 3.25: Client Orders Task 2 with Show All Errors feedback level

3.4 Pilot Study

A pilot study investigating the usability of Chreos Tutor was done during February and March 2015. This study was approved by the Human Ethics

Committee. All documentation associated with the study can be seen in Appendix B. The participants included five members of the Intelligent Computer Tutoring Research Group, two Chreos users and a lecturer from the Accounting and Information Systems department. They were introduced to the system, asked to attempt three particular tasks for each input screen and then complete a questionnaire. The questionnaire asked participants to rate certain aspects of the tutor and also provide open-ended feedback on those aspects.

The amount of time participants spent using Chreos Tutor ranged from 34 to 62 minutes, with an average time of 51 minutes. During this time six of the participants successfully completed either five or six of the set tasks, one completed three tasks and one did not submit a solution to any of the set tasks.

Analysis of the pilot study questionnaires indicates that participants without knowledge of the domain or Chreos struggled to understand how to fill out some of the Chreos input fields. They did not realise that dates only needed to be altered if the default value was inappropriate for the task. Some did not understand that they should use the combo box to select a client, and instead tried to enter the client name or code. There were also problems adding items to the order. Participants did not find it intuitive to select items from the Select item field below the grid and were not aware that the buttons below the grid had tooltips that explained their function.

Some participants indicated that instructions and help information Chreos Tutor provides would benefit from being less wordy and more visually descriptive. There were also some issues with task descriptions, particularly with respect to dates and other default settings.

On the plus side, the timing and style of feedback were generally found to be very helpful. Participants particularly liked the highlighting of incorrect fields with a red border and seemed to favour the 'Show all errors' or the 'View full solution' levels of feedback.

3.4.1 Final Version of Chreos Tutor

Chreos Tutor was changed in accordance with recommendations from the pilot study. The most important change is an introductory tutorial video for each domain. These tutorials move through the input fields in a logical order, discussing any default settings and how to input or select the appropriate data. The appropriate tutorial is available to users once they have selected a task type. The formatting of instructions and feedback has been improved and images are now incorporated where appropriate. Task descriptions and feedback messages have been overhauled. Chreos Tutor can now display the required dates in proper date format within any task description, regardless of the system dates in Chreos. The task description in Figure 3.26 indicates that the order is required by the client sometime during the month after next. The dates in brackets indicate that at the time the task is attempted (sometime in December 2015) the 'Not Before' date should be 1 February 2016 and the 'Deliver By' date should be 29 February 2016. This makes it possible to provide more clarity, particularly with the more simple tasks that would be attempted earlier in the learning process.

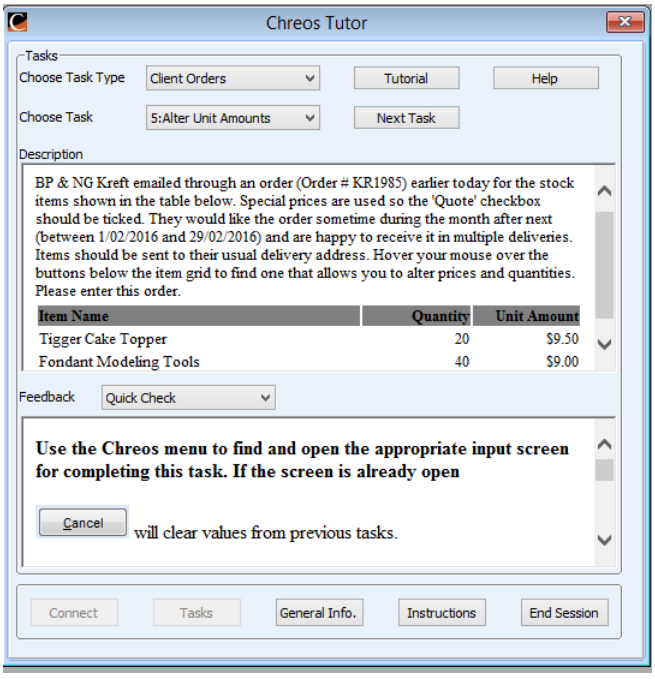

Figure 3.26: Chreos Tutor Final Version

Chapter IV

Evaluation

The main objective of this evaluation is to answer the question of whether an ITS embedded into Chreos business software is effective at teaching new users how to complete example tasks in Chreos. Existing training options incorporate some combination of human tutoring, use of a 'Practice Company', videos and help documentation. A 'Practice Company' is either a copy of the current database or an earlier backup. This enables users to try out various tasks, without impacting live data. It is not practical for the purposes of this research to have novice Chreos users evaluate Chreos Tutor. Chreos has a small user base and it is not possible to find enough new users to conduct a formal experiment to measure learning. Instead Chreos Tutor was evaluated by university students exposed to a different accounting system, as this is the best way we could approximate the background of a new Chreos user.

Neither is it practical to compare Chreos Tutor with existing training options. This would be logistically complex, difficult to control and measure and require excessive amounts of Chreos Support personnel and participant time. Feedback on performance errors is deemed to be the major learning tool within a CBT. Therefore the evaluation has been conducted by comparing Chreos Tutor with a more limited version that excludes all feedback pertaining to individual errors in the submitted solution. This version does not provide any feedback while the user is working on the task. Once the user submits their solution they are provided with a screenshot of the ideal solution, signaling that their work on that task is finished. Users are able to compare their solution with the ideal solution stored in Chreos Tutor, while still viewing the relevant task description.

In this chapter we present the experimental design and procedure, the participants and then move on to the results and analysis.

4.1 Experimental Design

The study was based on an experimental design with repeated measures involving two conditions. A full study version of Chreos Tutor was designed to automatically handle both the control group and experimental group requirements. It also incorporated automated sequencing of tasks within the pre-test, problem-solving and post-test phases. Participants were randomly allocated between the two conditions.

The control group version excluded all feedback from ASPIRE pertaining to individual errors in the submitted solution. Participants in this condition were only permitted to submit a single solution to each task and received no feedback while working on the task. Once users submitted their solution to Chreos Tutor they were provided a screenshot of the correct solution, which they could view in conjunction with their solution and the relevant task description. The next task started once the correct solution had been closed. Participants received the same tasks to complete and the same type of instructions from within Chreos as the experimental group. This includes logistical instructions about how to use Chreos Tutor in conjunction with Chreos input screens, plus screen specific help documentation and tutorial videos.

4.2 Procedure

The experiment consisted of a pre-test phase, a problem-solving phase and a post-test phase. Table 4.1 summarizes some of the specifications for each phase.

All participants were given an information sheet and completed a consent form. They were then given a few minutes to complete a background questionnaire, incorporating questions about gender, age, whether English is their first language, level of computer experience and the number of accounting systems they have used prior to the study. In addition, they were asked to indicate how confident they are in their ability to perform tasks in accounting packages. This was followed by an orientation period where participants were asked to log in to Chreos and received information on where

to find Chreos Tutor and input screens for the relevant module. They were also briefed on the three phase nature of their session, with the first pretest phase incorporating one task of each type.

Details	Pre-test	Problem-Solving	Post-test
Number of Tasks Available			
-Client Orders	1	6	1
-Debtor Journal	1	6	1
Manual Time Limit (Mins)	10	60	10
Tutorial and Help Available	No	Yes	No

Table 4.1: Chreos Tutor Session Phase Details

The pre-test phase was manually limited to ten minutes. Participants were given a client order task, followed by a debtor journal task. During this phase the screen-specific help documentation and tutorial videos were not available to participants. For each domain there is a minimum requirement which must be met before the Save button will become enabled. If participants do not achieve this minimum requirement then they cannot submit their solution to the tutor. At the end of the pretest time period, participants were asked to submit their solution of the current task to the tutor if possible.

The problem-solving phase of the session incorporated twelve tasks in total, made up of six client orders followed by six debtor journals. The order of tasks was identical for all participants. All participants were verbally informed that during this phase they would receive feedback from Chreos Tutor. They were advised to view the screen specific tutorial video, before attempting any tasks. This phase was manually limited to sixty minutes. At the end of that time, participants were asked to submit their solution of the current problem to the tutor if possible.

The post-test phase was identical to the pretest phase, except that the first task was a debtor journal and the second task was a client order. These tasks were similar but not identical to the pretest tasks.

After the post-test phase, participants completed a questionnaire, encouraging them to provide detailed feedback about their experience with Chreos Tutor. The first question was a repeat of the last question in the background

questionnaire, asking participants to indicate how confident they are in their ability to perform tasks in accounting packages. In subsequent questions participants were asked to indicate how effective the tutor was at teaching them how to complete tasks from the two domains. If they felt it was more effective with one type of task, they were asked to indicate why they thought that was the case. They were also asked to rate and comment on the feedback they received, indicate whether they thought Chreos Tutor was more effective than other training tools such as paper manuals and instructional videos and indicate whether they found it interesting to use. Participants could also include additional comments about any aspect of their experience with Chreos Tutor. For further information on individual questions please see the questionnaire in Appendix C.

4.3 Hypothesis

The experiment is designed to evaluate whether the feedback from Chreos Tutor pertaining to errors in the submitted solution is effective at teaching new users to correctly complete example tasks in Chreos. Feedback on performance errors is viewed as the major learning tool within a CBT.

4.4 Participants

All participants were university students from the Department of Accounting and Information Systems at the University of Canterbury, who were taking a course exposing them to the Xero accounting package. They were all between the ages of 18 and 29. Only one of the twelve students indicated that English was their first language. Participants were asked to rate their level of computer experience using a Likert-scale ranging from 1 to 7, with 7 indicating that they were very experienced. All participants rated themselves at somewhere between 3 and 5. Three participants had used a second accounting package in addition to Xero.

4.5 Results and Analysis

A total of twelve people participated in the study. A number of sessions were offered at various times in order to maximize the number of participants. Due to the haphazard nature of attendance at sessions, it was difficult to ensure an even split between the two conditions. Consequently there ended up being seven participants in the experimental group and five in the control group.

4.5.1 Pre-test and Post-test Phases

Table 4.2 summarizes the pre-test and post-test results (as percentages) for both domains and overall. The mean is presented along with the standard deviation in brackets. The maximum score for both tests is 20 in the client orders domain and 7 in the debtor journal domain.

In the client orders domain, the control group mean was 62.00% in the pre-test, 93.00% in the post-test and the normalized gain[1] was 72.67%. In comparison the experimental group had a pre-test mean of 52.86%, a post-test mean of 95.71% and a normalized gain of 87.74%.

In the debtor journal domain the control group mean was 40.00% in the pre-test and 94.29% in the post-test, with a normalized gain of 94.29%. This compares with the experimental group having a mean of 6.12% in the pre-test, 91.84% in the post-test and a normalized gain of 91.84%.

[1] calculated as post-test minus pretest result for each participant, divided by the maximum possible gain

	Control Group	Experimental Group
Client Orders		
Pre-Test	62.00 (34.93)	52.86 (36.95)
Post-Test	93.00 (2.74)	95.71 (5.35)
Normalized Gain	72.67 (22.41)	87.74 (13.32)
Debtor Journal		
Pre-Test	40.00 (43.33)	6.12 (16.20)
Post-Test	94.29 (7.82)	91.84 (21.60)
Normalized Gain	94.29 (7.82)	91.84 (21.60)
Overall		
Pre-Test	56.37 (32.79)	40.74 (28.77)
Post-Test	93.33 (3.09)	94.71 (7.05)
Normalized Gain	82.78 (4.97)	89.54 (16.16)

Table 4.2: Pre-test and Post-test Results as percentages: Mean(Std Dev)

The overall individual participant results from the pre-test were analysed using the Mann-Whitney U Test for independent samples. A p-value of 0.202 indicates that there was no significant difference in the pre-test results from both groups. This suggests that both the control and experimental groups had a similar level of knowledge about the two types of tasks in Chreos prior to using the tutor.

The post-test results and the normalized gain were also analysed to answer the question of whether the feedback from Chreos Tutor will help users learn how to complete the two types of tasks modeled by the tutor. A p-value of 0.432 suggests that there was no significant difference in the post-test results from both groups. However the normalized gain, weighted using the ratio of maximum score available for each type of task, returned a p-value of 0.048. The U value was 29.5, the median for the control group was 83.33 and the median for the experimental group was 93.33. This gives 95% confidence that the difference between the groups is not due to chance or sampling error. This suggests that Chreos Tutor will help users learn how to complete the modeled types of tasks better than the limited version, which only provides the correct solution after a task is completed.

All three participants that obtained 100 percent in the post-test were from the experimental group.

4.5.2 Problem-Solving Phase

Table 4.3 displays data from the client orders tasks and Table 4.4 contains data pertaining to the debtor journal tasks for the problem-solving phase of the experiment. This includes the total number of tasks attempted, categorized by whether they were solved or not, as well as the number of submissions made to the tutor and the time spent while attempting those tasks. The other item that is displayed is 'Learned1', which relates to all three phases of the study. 'Learned1' is based on a heuristic from the Student Model in Aspire. It measures the number of constraints the student has learnt while interacting with the tutor.

	Number of Tasks					
Group	Solved	Not Solved	Attempted	Submissions	Time (Mins)	Learned1
Control						
#1	1	3	4	4	25.8	1
#2	2	1	3	3	13.1	1
#3	3	2	5	5	23.3	0
#4	1	3	4	4	18.9	1
#5	1	5	6	6	39.3	5
Mean	1.60(0.89)	2.80(1.48)	4.40(1.14)	4.40(1.14)	24.08(9.78)	1.60(1.95)
Experimental						
#1	6	0	6	12	37.5	0
#2	4	1	5	57	47.0	3
#3	6	0	6	17	39.9	3
#4	5	0	5	28	43.6	5
#5	6	0	6	57	52.0	6
#6	6	0	6	25	42.4	6
#7	6	0	6	13	36.1	3
Mean	5.57(0.79)	0.14(0.38)	5.71(0.49)	29.86(19.45)	42.64(5.54)	3.71(2.14)

Table 4.3: Client Orders Data

	Number of Tasks					
Group	Solved	Not Solved	Attempted	Submissions	Time (Mins)	Learned1
Control						
#1	3	3	6	6	24.1	0
#2	4	2	6	6	11.8	0
#3	3	3	6	6	17.1	0
#4	4	2	6	6	23.6	0
#5	2	4	6	6	21.4	0
Mean	3.20(0.84)	2.80(0.84)	6.00(0.00)	6.00(0.00)	19.60(5.16)	0.00(0.00)
Experimental						
#1	6	0	6	7	28.0	0
#2	2	1	3	8	18.1	0
#3	6	0	6	8	20.2	0
#4	4	1	5	17	19.3	0
#5	1	0	1	2	11.5	0
#6	5	1	6	16	21.0	1
#7	6	0	6	11	24.6	0
Mean	4.29(2.06)	0.43(0.54)	4.71(1.98)	9.86(5.27)	20.39(5.19)	0.14(0.38)

Table 4.4: Debtor Journal Data

The experimental group solved a much higher proportion of attempted tasks in both domains than their peers from the control group. This is expected because in the problem-solving phase the experimental group were not able to move on to a new task until the current task was solved. As a consequence they also had a higher number of submissions, as they were allowed to submit multiple attempts per task until their solution was correct. It is interesting to note that the experimental group required a higher ratio of submissions per task to obtain the correct solution for client orders tasks than for debtor journal tasks.

The client orders data displayed in Table 4.3 and the debtor journal data from Table 4.4 were analysed using the Mann-Whitney U Test for independent samples. The results are displayed in Table 4.5.

	Median		Significant	
	Control Group	Experimental Group	U	p
Client Orders				
Number Tasks Solved	1	6	35.0	0.003
Number Tasks Not Solved	3	0	0.5	0.003
Submissions	4	25	35.0	0.003
Time (Mins)	23.3	42.4	33.0	0.010
Learned1	1	3	-	-
Debtor Journal				
Number Tasks Solved	3	5	-	-
Number Tasks Not Solved	3	0	0.0	0.003
Submissions	6	8	30.0	0.048
Time (Mins)	21.4	20.2	-	-
Learned1	0	0	-	-

Table 4.5: Mann-Whitney U Test Results

This indicates that there is a significant difference between the control and experimental groups with respect to client orders, when it comes to the number of tasks that were solved or not solved, the number of submissions and the time spent. This is expected, because in the problem-solving phase the experimental group were not able to move on to a new task until the current task was solved. This group made more submissions in their attempts to solve the problems and consequently spent more time doing this.

For the debtor journal domain there was no significant difference between the two groups with respect to the number of solved tasks, but the number of unsolved tasks was significantly higher for the control group. Once again the experimental group had a significantly higher number of submissions.

4.5.3 Questionnaire re Tutor Performance

The questionnaire contained six questions where participants were asked to rate the performance of various aspects of the tutor using Likert-scale ratings ranging from 1 to 7. A rating of 1 indicated a poor performance and a rating of 7 indicated that the tutor had excelled. Questions 2 and 3 asked their opinion on how well the tutor was able to teach them how to complete tasks. Question 6 asked if they were satisfied with the type and level of feedback

they received. Questions 8 and 9 asked whether the tutor was more effective than some other training options. Question 10 ascertained how interesting they found the tutor. Table 4.6 presents a summary of these questions and the mean responses from the control and experimental groups. For further information on individual questions please see the questionnaire in Appendix C.

Question	Control	Experimental
Was Chreos Tutor effective at teaching Client Orders?	5.60(0.89)	6.43(0.79)
Was Chreos Tutor effective at teaching Debtor Journals?	5.60(0.89)	4.71(1.60)
Were you satisfied with the type and level of feedback?	4.60(0.55)	5.71(1.11)
Was Chreos Tutor more effective than printed instructions?	5.80(0.84)	5.57(1.27)
Was Chreos Tutor more effective than instructional video?	6.00(0.71)	5.29(1.38)
Was Chreos Tutor interesting to use?	6.00(1.00)	6.00(1.15)

Table 4.6: Mean Likert-scale Responses for the Questionnaire

In addition there were some questions that involved written qualitative responses. This feedback was generally positive for both tutors. One recurring theme was that the information, help and feedback provided for the debtor journal tasks was not found to be as helpful as that provided for client orders. The participants felt that they did not come to understand this type of task as well as they would have liked. The participants also indicated that the process of viewing the tutorial videos needed to be more flexible, by giving them options to pause, rewind or fast forward. Lack of these features made it time consuming to look at parts of the video more than once. Two of the control group participants suggested that it would be better if the tutor provided feedback on their particular errors, instead of just showing them the full solution.

The experimental group on average rated Chreos Tutor as more effective at teaching client orders than the control group, but this view was reversed for debtor journals. Each member of the control group rated Chreos Tutor the same for both domains. However with the experimental group only one participant did this. Three participants rated Chreos Tutor one point lower for debtor journal, two participants rated it two points lower and one participant rated it five points lower. This suggests that participants found

the feedback relating to individual errors in submissions less helpful with respect to debtor journals, whereas the full solution was equally helpful for both types of tasks. This is supported by some of the experimental group responses to questions requiring qualitative feedback. Four different participants commented that there was a need to improve how debtor journal was taught or that debtor journals were more complex and required better explanation than client orders.

The experimental group gave the feedback a slightly higher rating than the control group. This is expected as the experimental group received additional feedback in relation to individual errors in the submitted solution. It was a little surprising that only two of the five control group participants mentioned the lack of this type of feedback.

The last question in the background questionnaire asked participants how confident they were in their ability to perform tasks in accounting packages. This question was repeated in the questionnaire completed after the study. This question had Likert-scale ratings ranging from 1 to 7, with 7 indicating a high confidence level. Table 4.7 displays the responses from before and after the study. One participant indicated that their confidence had dropped, two indicated their confidence level was unchanged and the remainder felt that they were more confident.

	Level of Confidence	
Group	Before	After
Control		
#1	5	5
#2	4	5
#3	3	4
#4	3	6
#5	5	5
Mean	4.00(1.00)	5.0(0.71)
Experimental		
#1	4	5
#2	2	5
#3	5	7
#4	3	5
#5	3	4
#6	3	5
#7	5	4
Mean	3.57(1.13)	5.00(1.00)

Table 4.7: Participant Confidence in Ability to Perform Tasks in Accounting Packages

4.6 Informal Evaluation by Chreos User

An informal evaluation of Chreos Tutor was completed by an experienced Chreos user, who had worked for at least one business using the Chreos Business System. In addition they had been employed as a support person at Wild Software for a period of time. The only difference between the version of Chreos Tutor they looked at and the version used by the experimental group in the formal study was the ability to select the domain and task, rather than this being automated. They did attempt the same sequence of tasks, but in their own time. A summary of their comments are presented below.

The user felt that Chreos Tutor was a more suitable training tool for new users than the existing help documentation. This documentation is more suited to experienced users who are looking for specific information. Instructional videos are insufficient on their own for new users, but they

thought that the videos included in Chreos Tutor were well-paced and acted as a type of introduction to how Chreos input fields work. They liked the graduated task descriptions, which provided more detail in earlier tasks and just basic information in later tasks. They commented that the style of feedback was excellent. Graduated levels encouraged people to figure things out for themselves, but the full solution was available for those who were really struggling. When asked to indicate which type of task they felt that the tutor was better at teaching, the response was debtor journals. Client orders are more complicated than debtor journals as there is more to learn.

On the negative side they found that the content of feedback messages with respect to errors in the client orders item grid was not as helpful as it could be. The messages needed to provide more detailed information about errors in a way that was meaningful to the user, rather than being limited by the way the grid was modeled.

4.7 Debtor Journal Versus Client Orders

There are some conflicting results and views with respect to the ability of Chreos Tutor to teach debtor journal tasks versus client orders tasks.

The control group on average performed marginally better in the debtor journal post-test than in the client orders post-test. However this result was reversed for the experimental group. For both groups the normalized learning gain from pre-test to post-test was higher for debtor journal than for client orders.

In the problem-solving phase the control group performed better on average with the debtor journal tasks. They solved 53% of the debtor journal tasks they attempted compared to 36% of the client orders tasks. In comparison the experimental group solved 91% of the debtor journal tasks they attempted and 98% of the client orders tasks. However their average number of submissions per task was much lower for debtor journal tasks than for client orders tasks.

Results from the questionnaire indicate that the control group rated Chreos Tutor the same for both domains, whereas the experimental group found Chreos Tutor more effective at teaching client orders than debtor jour-

nals. This is supported by four members of the experimental group commenting that there was a need to improve how debtor journal was taught or that debtor journals were more complex and required better explanation than client orders.

The Chreos user who completed an informal evaluation of Chreos Tutor felt that it was more effective at teaching debtor journals, because they are less complicated and there is less to learn than with client orders.

Debtor journals have seven input fields in total, five of which are applicable in 'Debtor' mode and six in 'General Ledger' mode. Four of the fields must always have a value and three are optional depending on the mode. Twenty two separate constraints exist for this domain in ASPIRE. Client orders have eleven simple input fields modeled in ASPIRE. Eight of these are mandatory and three are optional. The 'InvoiceGrid' component listing all the items included in the order is also part of the client orders domain. There must always be at least one item in an order. Each item is described by three distinct fields, the 'Itemref', the quantity and the unit price. Thirty five constraints exist for the client orders domain in ASPIRE.

The client orders domain sounds more complex. It contains more simple input fields plus the more complicated 'InvoiceGrid' component. There are thirteen additional constraints to be learnt. However there is only a single mode and the task resembles what many people do when ordering products over the internet. So the concept and purpose of entering a client order may not be unfamiliar to anyone between the ages of 18 and 29. They may also be comfortable with some of the types of information required and the screen layout. This is not the situation with debtor journals, where exposure would only occur within a business or accounting context.

The debtor journal task has two possible modes. In 'Debtor' mode it can be difficult to decide which client is the 'Source Client', which is the 'Second Client' and what sign the 'Amount' field should have. In reality they can be swapped and the sign of the 'Amount' field changed as appropriate. In Chreos Tutor these tasks have a single correct solution, with feedback messages indicating if a client swap has occurred. In 'General ledger account' mode all task descriptions are fairly clear about the appropriate General Ledger account and GST type, so the only difficult decision is the sign of

the ‘Amount’ field. The small number of fields make it reasonably easy to determine what information from the task description corresponds to which input field. So users may learn how to correctly enter a task using the tutor, without necessarily understanding the accounting concept behind the task. This may be compounded by the decision to intersperse tasks of both modes, rather than have users learn one mode first before being exposed to the second mode.

There is a need to consider why an experienced Chreos user felt that Chreos Tutor was more effective with debtor journals, when the majority of participants in the experimental group felt that there was a need to improve the way debtor journal was taught. Possibly the experienced Chreos user has a deeper understanding of the purpose of debtor journals than most of the participants in the study. The feedback messages were composed by someone with an excellent understanding of debtor journals. This may have resulted in them being more appropriate for those with a strong accounting background rather than novice users.

Chapter V

Conclusions

This thesis has presented the design and implementation of Chreos Tutor, an ITS embedded into the existing Chreos Business System to provide on-the-job training. The usability of the tutor was evaluated via a pilot study. The system was upgraded and then evaluated for learning from a further study incorporating a pre-test and post-test.

This chapter outlines the system, summarizes the results of the evaluations, describes the contributions and limitations of this research and presents a discussion of further work.

5.1 Chreos Tutor

Chreos Tutor is a CBT embedded into Chreos business software to provide novice users with opportunities to practice on realistic tasks in the actual software environment, at their convenience. Two different Chreos task types were selected for Chreos Tutor.

Debtor journals are used to make financial adjustments to debtor balances. They are used to deal with a range of situations such as: a receipt entered into Chreos for an incorrect value, writing off a small debtor balance when the debtor is no longer a client, writing off a balance that has become a bad debt, a receipt entered into Chreos that is subsequently reversed by the bank due to a lack of funds, when a payment from debtor A is incorrectly receipted to debtor B. The debtor journal screen was selected, because it is a standalone, single page screen with a small number of simple input fields. This made it easier to model and easier to extract user input.

The client orders screen is used to enter orders received from clients. Once an order is entered it can be converted to a Packing Slip or Invoice at the

appropriate time. The client orders screen was chosen, because it is one of the most commonly used screens by new users of Chreos. Once a user learns how to enter client orders correctly, they should be able to easily transfer those skills to the other tasks that use the same screen. The client orders screen also contains a grid, listing the items to be included in the order. Grids are a reasonably common component in Chreos so it is important to be able to successfully model them in Chreos Tutor.

These screens were modeled as individual non-procedural domains in a CBT developed using the ASPIRE authoring system. A task and solution structure was developed for each domain. Tasks and solutions complying with this structure were compiled and entered into ASPIRE. There were twelve debtor journal and sixteen client orders tasks. These tasks covered a range of difficulty levels, designed to introduce input fields in a graduated manner. Constraints representing the knowledge base of each domain were then generated by ASPIRE. Thirty five constraints were generated for the client orders domain, whereas the debtor journal domain contained eighteen generated and four manual constraints. These constraints are used to evaluate user solutions to tasks. If a solution does not violate any constraints then it is correct.

A new tutoring screen was embedded into Chreos to control all interaction between the user and the tutor. This screen forms part of the user interface and as such provides instructions, help, task descriptions and feedback. Users can attempt selected tasks from either of these domains in the actual Chreos input screens, which also become part of the user interface. Feedback is also provided on the input screens indicating input fields containing incorrect values.

A pilot study was conducted to gauge the usability of the tutor. The main finding was that participants without knowledge of the domain or Chreos struggled to understand how to fill out some of the Chreos input fields. An introductory tutorial video for each domain was included in the tutor to overcome this issue prior to a full study.

5.2 Evaluation

Chreos Tutor was evaluated by university students exposed to a different accounting system, as this was the best way we could approximate the background of new Chreos users. The experimental group used Chreos Tutor and the control group used a limited version that excluded all feedback pertaining to individual errors in the submitted solution. This version did not provide any feedback while a user was working on the task. Once the user submitted their solution they were provided with a screenshot of the ideal solution, signaling that their work on that task was finished.

The study consisted of three phases, a pre-test, a problem-solving phase and a post-test. Pre-test and post-test results showed no significant difference between the two groups. However there was a significant difference with the Normalized Gain, suggesting that students did learn the modeled types of tasks from Chreos Tutor better than the students using the version providing only the correct solution after task completion.

Students were also asked to fill out a questionnaire to provide feedback on their experiences with Chreos Tutor. Most comments about Chreos Tutor were positive. However some students felt that they did not come to understand the debtor journal domain as well as they would have liked.

5.3 Contributions

The user interface in Chreos Tutor was the combination of a new tutoring screen and an existing data input screen. Tasks were displayed in the tutoring screen, but they were completed in the data input screen. Feedback on errors was presented in both screens. Feedback in the tutoring screen was textual, but in the data input screen it consisted of red highlighting around the incorrect input fields. This is the first time a CBT has been embedded into an existing business system to teach data input tasks using the actual data input screens.

Analysis from an evaluation of Chreos Tutor showed that the normalized gain between pre-test and post-test was 82.78% for the control group and 89.54% for the experimental group. A learning gain of 89.54% suggests that

Chreos Tutor was effective in teaching new users how to complete the modeled tasks in Chreos. We have shown that it is possible for CBT's to effectively teach data input tasks.

5.4 Limitations

It was impractical for the purposes of this research to have novice Chreos users evaluate Chreos Tutor. Chreos has a small user base and it is not possible to find enough new users to conduct a formal experiment to measure learning. Instead, participants were university students exposed to a different accounting system. Neither was it practical to compare Chreos Tutor with existing training options. This would be logistically complex, difficult to control and measure and require excessive amounts of Chreos Support personnel and participant time. Chreos Tutor was evaluated by comparing it with a limited version that excluded all feedback pertaining to individual errors in the submitted solution. These two experiment design decisions are major limitations on the ability of this research to answer the question of whether embedding an ITS into Chreos business software will enhance the learning options available to novice users.

Sample size and time limitations also impacted on the study. Only a small number of students participated in the study and the amount of time they had available was limited. Only six tasks of each type were included in the problem-solving phase in order to keep session times to two hours. Each of the twelve debtor journal and sixteen client orders tasks were designed to make sequential contributions to task type learning. In addition there was no opportunity at a later point in time to evaluate how well participants retained what they had learnt from the tutor.

5.5 Further Work

There are several options for extending Chreos Tutor. It could be extended to encompass additional task types. A non-procedural approach was adopted with both the debtor journal and client orders task types. This reflected that the order in which fields are entered is not critical, provided everything is correct before the Save button is clicked. It would be interesting to model one

of the domains as a procedural tutor containing specific steps and ascertain whether this has any impact on learning.

The debtor journal screen in Chreos has two modes. In 'Debtor' mode two clients must be selected and the balance of each will be adjusted by the specified amount. The balance of one client will be increased and the balance of the other client will be decreased. In 'General ledger account' mode only one client is selected and the other side of the journal affects a General ledger account. The entry to the General ledger account also involves selecting a GST type. Tasks of both modes were interspersed throughout the sequence of example tasks provided to students during the evaluation study. It would be good to investigate whether changing the order and content of debtor journal tasks so that students learn about one mode at a time has an impact on student understanding of the domain.

It would be valuable to have one or more novice Chreos users try out Chreos Tutor. Their learning could be evaluated via some type of pre-test and post-test. It would then be useful to ascertain their views on the effectiveness of the tutor once they had been using Chreos for a while. This could provide insight into potential areas for improvement in the way that Chreos Tutor attempts to teach particular task types.

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Appendix A

Publications

This section contains the publications from this project.

J. de Jong, A. Mitrovic, and M. Mathews. Developing an Embedded Tutor for On-the-job Training. In H. Ogata et al. (Eds.) (2015). Proceedings of the 23rd International Conference on Computers in Education. China: Asia-Pacific Society for Computers in Education pp. 109-111.

J. de Jong, A. Mitrovic, and M. Mathews. An Embedded Constraint-based Tutor for On-the-Job Training. Under review.

Appendix B

Pilot Study Documents

This section contains all the documents associated with the Pilot Study.

Human Ethics Committee – Application Form

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

For Office Use Only –

HEC Reference: **Date Received:**

Please remember that your audience for this application form, as well as all forms for participants, will include community members and scholars from outside your discipline and therefore must be written in everyday language.

This form should be completed after reading the *Human Ethics Policy* issued by the Human Ethics Committee available at http://www.canterbury.ac.nz/humanethics

Please ***Bold*** your answers

DESCRIPTION OF THE PROJECT

1. What does the project seek to do? **The MSc project is about developing an Intelligent Tutoring System (ITS) into existing business software to provide On-the-Job training. Intelligent Tutoring Systems offer individualized support to each student, based on his/her knowledge, abilities and needs. The ITS developed in this project is embedded into the Chreos business software, and it teaches the user how to perform various functions in Chreos.**

2. What is the research question or hypothesis of this project? **The main objective of the research is to answer the question of whether embedding an Intelligent Tutoring System into Chreos business software will result in improved learning in comparison to training options available to novice users.**

3. Describe how this project arose (ie, please explain the academic area or issue etc which generated the question(s) to be examined – this is to allow lay members of the committee some context for the research.) **The goal of the project is to assess the feasibility of developing constraint-based ITSs that are embedded in existing software. We want to investigate whether such on-the-job training is effective.**

4. How will you go about answering the research question? **Embed the Intelligent Tutoring System into Chreos and have the system (Chreos Tutor) evaluated by one or more groups of people. Currently we want to do a pilot study to evaluate the usability of a**

prototype Chreos Tutor. Information from this study will help determine the design of a final prototype.

INFORMATION ABOUT THE PARTICIPANTS

5. Who are the participants and why have they been chosen to be asked to participate? **The participants will be a small group of researchers and postgraduate students from the Intelligent Computer Tutoring Group (ICTG) at the University of Canterbury, plus a couple of employees and existing Chreos users. This application is only for a pilot study, so the choice of users is not critical. We would like to have a mixture of novices and more experienced users of Chreos.**

6. How many participants will be involved (of each category where relevant)? **This application is for a pilot study and we plan to have 8-10 participants only.**

7. What selection criteria and/or exclusion criteria will you use? **As specified above, this application is for a pilot study and we plan to have 8 participants only. The goal of the pilot study is to identify any deficiencies of the prototype, rather than to evaluate its effectiveness. For that reason, there are no specific criteria for selecting participants apart from their availability.**

8. Describe how potential participants will be identified and recruited? **The participants will be members of ICTG and employees/users of Chreos.**

9. Does the project involve recruitment through advertising? **No**

10. How much time are participants asked to contribute to the research? **Approximately one hour.**

11. Is any form of inducement to be offered? **NO**

12. How will the participants be treated? **They will be given a brief introduction to Chreos and Chreos Tutor (10 mins). After the introduction, they will be asked to carry out a list of tasks in Chreos Tutor using a computer keyboard and mouse (45 minutes) and then be asked to complete a questionnaire (15 minutes).**

OTHER PARTIES WITH AN INTEREST IN THE RESEARCH

13. Does the project require permission of an organisation, other people, to access participants or information? **YES. There will be some Chreos users included in the pilot study. The Manager of Wild Software Ltd has given permission for a support staff member and a client to be approached about participating in the study.**

14. Will the project require Maori consultation? **NO**

15. Will the project require Community consultation? **NO**

16. Is the project funded externally? **NO**

17. Is the project commissioned by or carried out on behalf of an external organisation(s)? **NO**

18. Is the project to be part of the CEISMIC digital archive? **NO**

DATA COLLECTION

19. Does the project involve a questionnaire? **YES**

    (a) Explain how and why the questionnaire(s) will be anonymous or confidential. **The questionnaire will be confidential. There are some additional questions for Chreos users as they will offer a different perspective on the usability of the prototype Chreos Tutor. Any report on the results of the study will be summarized.**

    (b) Explain how the questionnaire will be distributed and collected. **The questionnaire will be distributed on paper and collected at the pilot study.**

20. Does the project involve a structured or semi-structured interview? **NO**

21. Does the project involve an unstructured interview? **NO**

22. Does the project involve focus groups? **NO**

23. Does the project involve recording of Audio, Video or Images? **NO**

24. Will participants will be given the opportunity to check the transcript and/or notes of their interview/focus group? **N/A**

INFORMED AND VOLUNTARY CONSENT

25. By whom and how will information be given to potential participants? **Jill de Jong will introduce the study and distribute the forms.**

26. Are all participants competent to give consent on their own behalf? **YES**

    If no, please explain,

    (a) why they are not competent to give informed consent on their behalf?

    (b) how consent will be obtained in the absence of that competency?

    (c) if applicable, how will assent to participate be gained?

PRIVACY AND CONFIDENTIALITY

27. Will information pertaining to or about the participants be obtained from any source other than the participant? **NO**

    (a) the identity of the third party or parties.

    (b) why such information is needed.

    (c) how will you obtain consent from the participant and the third party(ies) to gather that data.

    (d) the processes you will use to obtain that data.

28. Is information that identifies participants to be given to any person outside the research team, or if identification of or attribution of comments by participants is sought, please explain how and why. **NO**

29. Please explain how confidentiality of the participants' identities will be maintained in the treatment and use of the data. **The forms collected during the pilot study will be kept in a locked cabinet, with Jill de Jong being the only person who will have access to it. The data will be coded and summarized, and only summaries will be available in any publications arising from the study.**

30. Is an institution (eg, school, business, etc) to which participants belong to be named or be able to be identified in the publication or presentation of this project? **NO**

31. Where will the project be conducted? **The pilot study will be conducted in a computer lab in the Erskine building (UC).**

RISK

32. Is there any risk to physical well-being? **NO**

33. Could participation involve mental stress or emotional distress? **NO**

34. Is there a possibility of causing moral or cultural offence, inadvertently or otherwise? **NO**

34. Is deception involved at any stage of the project? **NO**

35.

DATA STORAGE AND FUTURE USE

35. Please provide details of how the data will be securely stored, and how you will separate identifying and non-identifying data. **The collected forms will be kept in a locked cabinet at the ICTG lab at the University of Canterbury. The coded data will be kept in password-protected files on a password-protected computer.**

36. Who, apart from the researcher and their supervisor (where applicable) will have authorised access to the data? **No one**

37. What will happen to the raw data at the end of the project? **The data will be destroyed 5 years after the completion of the MSc.**

38. What plans do you have for the publication of the data? **We do not expect any publishable results, as this application is only for a pilot study. The results will be used to improve the prototype of the Chreos Tutor.**

39. Please describe plans for future use of the data beyond those already described above. **There are no other plans.**

Department of Computer Science and Software Engineering
Email: jill.dejong@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Chreos Tutor Pilot Study: Consent Form

I have been given a full explanation of this study and have had the opportunity to ask questions.

I understand what is required of me if I agree to take part in the research.

I understand that participation is voluntary and I may withdraw at any time without penalty. Withdrawal of participation will also include the withdrawal of any information I have provided should this remain practically achievable.

I understand that any information or opinions I provide will be kept confidential to the researcher and that any published or reported results will not identify the participants.

I understand that all data collected for this study will be kept in locked and secure facilities at the University of Canterbury and will be destroyed after five years.

I understand that I am able to receive a report on the findings of the study by contacting the researcher at the conclusion of the study.

I understand that I can contact the researcher Jill de Jong (jill.dejong@pg.canterbury.ac.nz) or supervisors Prof Tanja Mitrovic (tanja.mitrovic@canterbury.ac.nz) and Dr Moffat Mathews (moffat.mathews@canterbury.ac.nz) for further information. If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz)

By signing below, I agree to participate in this research project.

Name: _____

Signed: _____

Date: _____

Please return this form to Jill de Jong upon undertaking the study.

Jill de Jong

Department of Computer Science and Software Engineering
Email: jill.dejong@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Chreos Tutor Pilot Study: Information Sheet

I am a Masters student in the Department of Computer Science and Software Engineering at the University of Canterbury. I am currently conducting a research project that investigates whether embedding an Intelligent Tutoring System into Chreos business software will enhance the learning options available to novice users. I would like to invite you to participate in my pilot study. If you agree to participate, you will be asked to do the following:

- Listen to a brief introduction to Chreos.
- Attempt a specified list of tasks using Chreos Tutor.
- Complete a short questionnaire regarding your experience with the tutor.
- The whole process should take approximately 1 hour.

Please note that participation in this study is voluntary. If you do participate, you have the right to withdraw from the study at any time without penalty. If you withdraw, I will do my best to remove any information relating to you, provided this is practically achievable.

I will take particular care to ensure the confidentiality of all data gathered for this study. I will also take care to ensure your anonymity in publications of the findings. All the data will be securely stored in password protected facilities and locked storage at the University of Canterbury for five years following the study. It will then be destroyed.

The results of this research may be used to improve the design of Chreos Tutor. You may receive a copy of the project results by contacting the researcher at the conclusion of the project.

The project is being carried out as part of a Masters Research Project at the University of Canterbury by Jill de Jong under the supervision of Prof Tanja Mitrovic and Dr. Moffat Mathews, who can be contacted at tanja.mitrovic@canterbury.ac.nz and moffat.mathews@canterbury.ac.nz respectively. They will be pleased to discuss any concerns you may have about participation in the project.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (Human-ethics@canterbury.ac.nz).

If you agree to participate in the study, you are asked to complete the consent form and return it to Jill de Jong upon undertaking the study.

Jill de Jong

Chreos Tutor Pilot Study

Questionnaire

Thank you for participating in my pilot study—your feedback is crucial to my current and future research. This questionnaire is anonymous and if you wish, you may at any time withdraw from participation, including withdrawal of any information you have provided. However, by completing the questionnaire, you indicate your consent for publication of the summarized results of our research findings.

1. Please indicate whether you have any knowledge or understanding of accounting processes.

Not very much						Very much
1	2	3	4	5	6	7

2. Please indicate your level of experience with computerised accounting or business systems **prior to participating in this study**.

Not very experienced						Very experienced
1	2	3	4	5	6	7

3. Please indicate whether you have used the Chreos Integrated Business System at all. Yes/No

If the answer is yes, then please answer the additional questions for Chreos users at the end of this questionnaire.

4. Please indicate your level of experience with Intelligent Tutoring systems **prior to participating in this study**.

Not very much						Very much
1	2	3	4	5	6	7

5. Was Chreos Tutor intuitive to use? Consider whether you had trouble getting started, whether the tutor screen layout made sense to you, whether the tutor could have made things easier for you and so on.

Not very intuitive						Very intuitive
1	2	3	4	5	6	7

6. Please provide any additional feedback you may have regarding the usability of the tutor.

7. Were you satisfied with the accessibility and content of the help information provided by the tutor?

Not very satisfied						Very satisfied
1	2	3	4	5	6	7

8. Please provide any additional feedback you may have regarding the help information.

9. Were you satisfied with the type and level of feedback (text and highlighting) you received from the tutor as you performed the tasks?

Not very satisfied						Very satisfied
1	2	3	4	5	6	7

10. Please provide any additional feedback you may have regarding the usefulness of feedback.

11. Was Chreos Tutor helpful in teaching you how to correctly enter tasks into the appropriate Chreos screens?

Not very helpful						Very helpful
1	2	3	4	5	6	7

12. Please share any additional feedback you may have regarding the overall effectiveness of the tutor.

13. Please provide any additional comments about your experience. This could include details about what you liked, what you didn't like, or what could be improved.

Additional Questions for Chreos Users

14. Please indicate how many years you have been using Chreos.

15. Please indicate your level of experience with using the Debtor Journal screen in Chreos **prior to participating in this study**.

Not very experienced						Very experienced
1	2	3	4	5	6	7

16. Please indicate your level of experience with using the Client Orders screen in Chreos **prior to participating in this study**.

Not very experienced						Very experienced
1	2	3	4	5	6	7

17. Do you think the task descriptions used in Chreos Tutor are realistic?

Not very realistic						Very realistic
1	2	3	4	5	6	7

18. Please provide any additional feedback about how to make the task descriptions more realistic.

19. Do you think Chreos Tutor is a useful addition to the existing methods for teaching new or existing Chreos users how to use a screen they are not familiar with?

Not very useful						Very useful
1	2	3	4	5	6	7

20. Please provide any additional feedback about why you think Chreos Tutor is or is not a useful addition to existing teaching methods.

21. Do you think Chreos Tutor is more effective with one type of task than the other? If so, please indicate which one and why.

Appendix C

Full Study Documents

This section contains all the documents associated with the Full Study.

Human Ethics Committee – Student Application

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

For Office Use Only –	**HEC Reference:**	
Date Received:	**Reviewers:**	
Date Approved:	**Approved:**	**(HEC Chair)**

HUMAN ETHICS APPLICATION COVERSHEET – STUDENT

Please remember that your audience for this application form, as well as all forms for participants, will include community members and scholars from outside your discipline and therefore must be written in everyday language.
This form should be completed after reading the *Human Ethics Policy* issued by the Human Ethics Committee available at http://www.canterbury.ac.nz/humanethics

Will another ethics committee review this application?

- If a New Zealand Health and Disability Ethics Committee (HDEC) is reviewing your project, please send your HDEC application to us with this coversheet, and then the approval. You do not need to fill out the full University of Canterbury application form.
- If you have ethics approval from another institutional ethics committee (eg another New Zealand or Overseas University ethics committee) and you will conduct your research in the country of that ethics committee, please send this coversheet only with that application and the later approval letter, and an explanatory email. You do not, initially, need to fill out the full University of Canterbury application form.

Please ***Bold*** your answers

Project Title: Embedding an Intelligent Tutor into existing Business Software to provide On-the-Job Training

Status of Research: Masters

Applicant

Name: **Jill de Jong**

University Programme/ Department: **Computer Science and Software Engineering**

Applicant's Email: **jill.dejong@pg.canterbury.ac.nz**

Primary Telephone No: **03 339 4290**

Primary Supervisor Title, given name and family name

Name: **Tanja Mitrovic**

University Programme/ Department: **Computer Science and Software Engineering**

Supervisor's Email: tanja.mitrovic@canterbury.ac.nz

Primary Telephone No: **6352**

Other Supervisors: **Dr Moffat Mathews, CSSE**

RESEARCHER'S SIGNATURE

I, Jill de Jong have considered, the various ethical issues involved in this research, I have discussed this proposal with my supervisor(s), and I will conduct this research within the bounds of any approval given by the Human Ethics Committee of the University of Canterbury.

Signed: Jill de Jong Dated: 24.7.2015

Is the approval of this application a necessary pre-requisite for the Dean of Postgraduate Studies to formally accept your PhD proposal? [YES/NO]

SENIOR SUPERVISOR'S SIGNATURE

As the primary supervisor of Jill de Jong research project I, Tanja Mitrovic consider that the design and documentation are of a standard appropriate for a research project carried out in the name of the University of Canterbury.

Signed: Tanja Mitrovic Dated: 24.7.2015

LOW RISK PROCESSES (TO BE COMPLETED BY THE PRIMARY SUPERVISOR)

Please explain why the research is low risk research low risk, noting the information overleaf

The study is considered low risk because it does not raise any issues of deception, threat, invasion of privacy, mental, physical or cultural. It also does not involve the gathering of personal information of sensitive nature about or from individuals. It does not raise any risks to the participants or to the researcher.

Participants will be given an information sheet describing the study and are asked to sign a consent form if they agree. Any information gathered will be confidential, and can be withdrawn by the participant at any stage. Furthermore, all data collected will only be viewed by the researcher and his supervisors. Confidentiality of the collected data will be preserved in any publication about this research.

Signed (Senior/Primary Supervisor only) _____ Dated: 24.7.2015

SUBMISSION INSTRUCTIONS.

Please submit ONE electronic file containing all the necessary documents in a PDF format and ONE fully signed hard copy. Exceptions may be made, but must be discussed first with the HEC Secretary. Processing of HEC applications is unable to begin until a hard copy of the application has been received by the Ethics Office.
Electronic copies should be emailed to human-ethics@canterbury.ac.nz. Hard copies should be sent to the Secretary, Human Ethics Committee (Level 5, Matariki South).

Low Risk application information:

Research may be considered low risk when it arises from

a Masters or PhD theses where the projects do not raise any issue of deception, threat, invasion of privacy, mental, physical or cultural risk or stress, and do not involve gathering personal information of a sensitive nature about or from individuals.

b Masters or PhD level supervised projects undertaken as part of specific course requirements where the projects do not raise any issue of deception, threat, invasion of privacy, mental, physical or cultural risk or stress, and do not involve gathering personal information of sensitive nature about or from individuals.

c Undergraduate and Honours class research projects which do not raise any issue of deception, threat, invasion of privacy, mental, physical or cultural risk or stress, and do not involve gathering personal information of sensitive nature about or from individuals, but do not have blanket approval as specified in Section 4 of the Principles and Guidelines.

3. No research can be counted as low risk if it involves:

(i) invasive physical procedures or potential for physical harm
(ii) procedures which might cause mental/emotional stress or distress, moral or cultural offence
(iii) personal or sensitive issues
(iv) vulnerable groups
(v) Tangata Whenua (if in doubt please see the comments under question 12 on the application form)
(vi) cross cultural research
(vii) investigation of illegal behaviour(s)
(viii) invasion of privacy
(ix) collection of information that might be disadvantageous to the participant
(x) use of information already collected that is not in the public arena which might be disadvantageous to the participant
(xi) use of information already collected which was collected under agreement of confidentiality
(xii) participants who are unable to give informed consent
(xiii) conflict of interest e.g. the researcher is also the lecturer, teacher, treatment-provider, colleague or employer of the research participants, or there is any other power relationship between the researcher and the research participants.
(xiv) deception
(xv) audio or visual recording without consent
(xvi) withholding benefits from "control" groups
(xvii) inducements
(xviii) risks to the researcher

This list is not definitive but is intended to sensitise the researcher to the types of issues to be considered. Low risk research would involve the same risk as might be encountered in normal daily life.

DESCRIPTION OF THE PROJECT

1. What does the project seek to do? **The MSc project is about developing an Intelligent Tutoring System (ITS) for existing business software to provide On-the-Job training. Intelligent Tutoring Systems offer individualized support to each student, based on his/her knowledge, abilities and needs. The ITS developed in this project is embedded into the Chreos business software, and it teaches the user how to perform various functions in Chreos.**

2. What is the research question or hypothesis of this project? **The main objective of the research is to answer the question of whether embedding an Intelligent Tutoring System into Chreos business software will result in improved learning in comparison to training options available to novice users.**

3. Describe how this project arose ie, please explain the academic area or issue etc which generated the question(s) to be examined – this is to allow lay members of the committee some context for the research. **The goal of the project is to assess the feasibility of developing constraint-based ITSs that are embedded in existing software. We want to investigate whether such on-the-job training is effective.**

4. How will you go about answering the research question? **Embed the Intelligent Tutoring System into Chreos and have the system (Chreos Tutor) evaluated by one or more groups of people. This application follows on from a pilot study done earlier in the year to evaluate the usability of a prototype Chreos Tutor. The participants will be split into Control and Experimental groups.**

INFORMATION ABOUT THE PARTICIPANTS

1. Who are the participants and why have they been chosen to be asked to participate? **The size of the Chreos user base means that there will not be enough real novice Chreos users for a full study of Chreos Tutor. The participants will be students from the Accounting and Information Systems Department who are taking or have completed a course looking at a different accounting system (INFO243). These students will have some domain knowledge and should approximate the type of person who would be a novice user of Chreos.**

2. How many participants will be involved (of each category where relevant)? Please include statistical justification where necessary. **We would like a minimum of 20 participants in each of the Control and Experimental groups.**

3. What selection criteria and/or exclusion criteria will you use? ie, randomly, by age, gender, ethnic origin, other – please give details. What plans do you have if the recruitment phase is too successful, or does not recruit enough participants? **As specified above, participants need to be taking or have completed INFO243. Such students would only be excluded if they have already used Chreos.**

4. Describe how potential participants will be identified and recruited? **An email will be sent to students enrolled in INFO243 in the second semester, plus students that have previously taken this course, with assistance from the course supervisor.**

5. Does the project involve recruitment through advertising? YES

6. How much time are participants asked to contribute to the research? **Approximately two hours.**

7. Is any form of inducement to be offered? YES, a $10.00 Reboot voucher funded by the Computer Science Department.

8. How will the participants be treated? **They will be given a brief introduction to Chreos and then be asked to complete a general background questionnaire (10 mins). They will then be asked to carry out 2 pre-test tasks with a manual time limit (10 mins), a number of full study tasks with a manual time limit (60 mins) and 2 post-test tasks with a manual time limit (10 mins). These tasks will be done in Chreos Tutor using a computer keyboard and mouse. Finally they will be asked to complete a questionnaire about their experiences with the tutor (10 mins).**

OTHER PARTIES WITH AN INTEREST IN THE RESEARCH

9. Does the project require permission of an organisation, other people, to access participants or information? **NO**

10. Will the project require Maori consultation? **NO**

11. Will the project require Community consultation? **NO**

12. Is the project funded externally? **NO**

13. Is the project commissioned by or carried out on behalf of an external organisation(s)? **NO**

14. Is the project to be part of the CEISMIC digital archive? **NO**

DATA COLLECTION

15. Does the project involve a questionnaire? **YES** If there is a questionnaire please answer the following questions:

(a) Explain how and why the questionnaire(s) will be anonymous or confidential **The questionnaire will be confidential. Any report on the results of the study will be summarized.**

(b) Explain how the questionnaire will be distributed and collected. **The questionnaire will be distributed on paper and collected at the study.**

16. Does the project involve a structured or semi-structured interview? **NO**
17. Does the project involve an unstructured interview? NO
18. Does the project involve focus groups? NO
19. Does the project involve recording of Audio, Video or Images? NO
20. Will participants will be given the opportunity to check the transcript and/or notes of their interview/focus group? N/A

INFORMED AND VOLUNTARY CONSENT

Please note: The HEC recommends that participants receive an information sheet, which they must be able to retain, unless there are good reasons for not adopting such a procedure. The information sheet(s) and the consent form(s) should be separate. Projects which **only** involve an anonymous questionnaire may not necessarily require a separate information sheet, provided that the questionnaire includes your name and contact number as well as the other points contained in the information and consent templates available on the HEC website. *Please note: so that participants can retain a copy of the information sheets, the information sheet(s) and the consent form(s) should be separate.*

21. By whom and how will information be given to potential participants? **Jill de Jong will introduce the study and distribute the forms.**
22. Are all participants competent to give consent on their own behalf? YES If no, please explain,
    (a) why they are not competent to give informed consent on their behalf?
    (b) how consent will be obtained in the absence of that competency?
    (c) if applicable, how will assent to participate be gained?

PRIVACY AND CONFIDENTIALITY

23. Will information pertaining to or about the participants be obtained from any source other than the participant? NO
    (a) the identity of the third party or parties.

(b) why such information is needed.

(c) how will you obtain consent from the participant and the third party(ies) to gather that data.

(d) the processes you will use to obtain that data

24. Is information that identifies participants to be given to any person outside the research team, or if identification of or attribution of comments by participants is sought, please explain how and why. **NO**

25. Please explain how confidentiality of the participants' identities will be maintained in the treatment and use of the data. **The forms collected during the study will be kept in a locked cabinet, with Jill de Jong being the only person who will have access to it. The data will be coded and summarized, and only summaries will be available in any publications arising from the study.**

26. Is an institution (eg, school, business, etc) to which participants belong to be named or be able to be identified in the publication or presentation of this project? **YES. Participants will be identified as being Accounting and Information Systems students who have been exposed to a different accounting system.**

27. Where will the project be conducted? **The study will be conducted in a computer lab in the Erskine building (UC).**

RISK

If the answer to any of the following questions is "Yes", please indicate briefly the nature of the risk and what actions you could take, or support mechanisms you could rely on, if a participant should become injured, distressed or offended while taking part in this project. In order to maintain a distinction between the researcher and other roles, support should not be undertaken by researcher. At the very least, a list of support services should be included in the information sheet and also participants made aware of the possibility in the information sheet.

28. Is there any risk to physical well-being? **NO**

29. Could participation involve mental stress or emotional distress? **NO**

30. Is there a possibility of causing moral or cultural offence, inadvertently or otherwise? **NO**

31. Is deception involved at any stage of the project? **NO**

DATA STORAGE AND FUTURE USE

32. Please provide details of how the data will be securely stored, and how you will separate identifying and non-identifying data. **The collected forms will be kept in a locked cabinet**

at the ICTG lab at the University of Canterbury. The coded data will be kept in password-protected files on a password-protected computer.

33. Who, apart from the researcher and their supervisor (where applicable) will have authorised access to the data? **No one**

34. What will happen to the raw data at the end of the project? **The data will be destroyed 5 years after the completion of the MSc.**

35. What plans do you have for the publication of the data? **We plan to write several conference and journal papers resulting from the study.**

36. Please describe plans for future use of the data beyond those already described above. **There are no other plans.**

Department of Computer Science and Software Engineering
Email: jill.dejong@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Chreos Tutor Study: Consent Form

I have been given a full explanation of this study and have had the opportunity to ask questions.

I understand what is required of me if I agree to take part in the research.

I understand that participation is voluntary and I may withdraw at any time without penalty. Withdrawal of participation will also include the withdrawal of any information I have provided should this remain practically achievable.

I understand that any information or opinions I provide will be kept confidential to the researcher and that any published or reported results will not identify the participants.

I understand that all data collected for this study will be kept in locked and secure facilities at the University of Canterbury and will be destroyed after five years.

I understand that I am able to receive a report on the findings of the study by contacting the researcher at the conclusion of the study.

I understand that I can contact the researcher Jill de Jong (jill.dejong@pg.canterbury.ac.nz) or supervisors Prof Tanja Mitrovic (tanja.mitrovic@canterbury.ac.nz) and Dr Moffat Mathews (moffat.mathews@canterbury.ac.nz) for further information. If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz)

By signing below, I agree to participate in this research project.

Name: _____

Signed: _____

Date: _____

Please return this form to Jill de Jong upon undertaking the study.

Jill de Jong

Department of Computer Science and Software Engineering
Email: jill.dejong@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Chreos Tutor Study: Information Sheet

I am a Masters student in the Department of Computer Science and Software Engineering at the University of Canterbury. I am currently conducting a research project that investigates whether embedding an Intelligent Tutoring System into Chreos business software will enhance the learning options available to novice users. I would like to invite you to participate in my study. If you agree to participate, you will be asked to do the following:

- Listen to a brief introduction to Chreos.
- Complete a short questionnaire about your background.
- Attempt 2 pre-test tasks
- Attempt a specified list of tasks using Chreos Tutor.
- Attempt 2 post-test tasks
- Complete a questionnaire regarding your experience with the tutor.
- The whole process should take approximately 2 hours.

Please note that participation in this study is voluntary. If you do participate, you have the right to withdraw from the study at any time without penalty. If you withdraw, I will do my best to remove any information relating to you, provided this is practically achievable.

I will take particular care to ensure the confidentiality of all data gathered for this study. I will also take care to ensure your anonymity in publications of the findings. All the data will be securely stored in password protected facilities and locked storage at the University of Canterbury for five years following the study. It will then be destroyed.

You may receive a copy of the project results by contacting the researcher at the conclusion of the project.

The project is being carried out as part of a Masters Research Project at the University of Canterbury by Jill de Jong under the supervision of Prof Tanja Mitrovic and Dr. Moffat Mathews, who can be contacted at tanja.mitrovic@canterbury.ac.nz and moffat.mathews@canterbury.ac.nz respectively. They will be pleased to discuss any concerns you may have about participation in the project.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (Human-ethics@canterbury.ac.nz).

If you agree to participate in the study, you are asked to complete the consent form and return it to Jill de Jong upon undertaking the study.

Jill de Jong

Chreos Tutor Study

Background Questionnaire

Thank you for participating in my evaluation study—your feedback is crucial to my current and future research. This questionnaire is anonymous and if you wish, you may at any time withdraw from participation, including withdrawal of any information you have provided. However, by completing the questionnaire, you indicate your consent for publication of the generalized results of our research findings.

1. Please indicate your gender

☐ Male ☐ Female ☐ Other

2. Please indicate your age

_____ years

3. Is English your first language? Yes / No

4. How would you describe the level of your computer experience?

Not very experienced						Very experienced
1	2	3	4	5	6	7

5. How many accounting systems have you used **prior to participating in this study?** Please indicate, if possible, the names of those systems.

6. How confident are you in your ability to perform tasks in accounting packages?

Not very confident						Very confident
1	2	3	4	5	6	7

Chreos Tutor Study

Questionnaire

Thank you for participating in my evaluation study—your feedback is crucial to my current and future research. This questionnaire is anonymous and if you wish, you may at any time withdraw from participation, including withdrawal of any information you have provided. However, by completing the questionnaire, you indicate your consent for publication of the generalized results of our research findings.

1. How confident are you in your ability to perform tasks in accounting packages?

Not very confident						Very confident
1	2	3	4	5	6	7

2. Was Chreos Tutor able to teach you how to correctly enter Client Orders into Chreos?

Not very much						Very much
1	2	3	4	5	6	7

3. Was Chreos Tutor able to teach you how to correctly enter Debtor Journals into Chreos?

Not very much						Very much
1	2	3	4	5	6	7

4. Do you think Chreos Tutor was equally effective at teaching both types of tasks or more effective with one type? If you think it was more effective at teaching one type of task please specify which one and indicate why you think that is.

5. Please share any additional feedback you may have regarding the overall effectiveness of Chreos tutor.

6. Were you satisfied with the type and level of feedback you received from the tutor as you performed the tasks?

Not very much						Very much
1	2	3	4	5	6	7

7. Please provide any additional comments you may have regarding the feedback.

8. Do you think Chreos Tutor was a more effective method of teaching you how to enter Client Orders and Debtor Journals than printed instructions (e.g. reading a manual)?

Not very much						Very much
1	2	3	4	5	6	7

9. Do you think Chreos Tutor was a more effective method of teaching you how to enter Client Orders and Debtor Journals than an instructional video?

Not very much						Very much
1	2	3	4	5	6	7

10. Do you think Chreos Tutor is interesting to use?

Not very much						Very much
1	2	3	4	5	6	7

11. Please provide any additional comments about your experience. This could include details about what you liked, what you didn't like, or what could be improved.